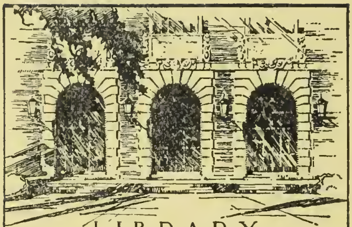


LIBRARY
OF THE
UNIVERSITY
OF ILLINOIS

630.7
V591c
no.1-14
cop. 2

AGRICULTURE

Digitized by the Internet Archive
in 2016

https://archive.org/details/circular114verm

30.7
59lc

UNIVERSITY
AGRICULTURE

Vermont Agricultural Experiment Station

BURLINGTON, VT.

CIRCULAR No. 1

March, 1909

THE BULLETINS OF THE FERTILIZER CONTROL

JOSEPH L. HILLS, DIRECTOR.

It is a settled policy at this Station yearly to "feature" some special topic in its main annual fertilizer bulletin. This plan was inaugurated in 1902, and presumably will be pursued for several years to come. Thus the recipient of these bulletins who preserves them will in time possess a more or less complete treatise on the general subject of fertilization.

The issuance of the principal bulletin of the year dealing with commercial fertilizers is necessarily delayed until the close of the inspectional work which because of its volume cannot be finished before June. Midsummer, however, is not a time when farmers are as apt to read such treatises as at, or before, the time of purchase. Hence it is that *this circular is issued to call attention to these past publications—many of which are on hand in considerable numbers—so that such as may wish to get and study them may do so.* (See last page).

In each bulletin analyses have been printed, comparisons with guaranties instituted, and the relationship of selling prices and money values of the plant food contents discussed. It is necessary yearly to make and to print analyses and to comment thereon, and advisable annually to discuss the financial phase of the proposition. The special "features," however, have been introduced in the hope—which the writer is optimistic enough to believe is to some extent being realized—that such a survey may aid in placing Vermont farm practice upon a higher plane.

The following statement outlines these "features" to date:

Bulletin 93 (1902). *Formulas for home mixing.*—The nature and composition of the crude stock or ingredients used, suggestions as to their choice for sundry uses and as to their compounding, together with many formulas, using all sorts of crude stock and providing for almost every grade of goods. (56 pages).

Bulletin 99 (1903). *Vermont's usage of fertilizers.*—A review of data drawn from the last census, showing usage by counties; a comparison of commercial fertilizer consumption in Vermont and in other states.

Concerning fertilizer buying.—An exposition of the meaning of guaranties; of the lack of meaning to brand names; of the true inwardness of the valuation system, what it is and what it is not, arguments for and against it and the method of its use; of the agricultural value of a fertilizer, and the distinction between agricultural and commercial values; and of the forms of plant food.

Deficient plant food.—A discussion of the nature and functions of the sundry forms of nitrogen, phosphoric acid, potash, and lime, together with statements concerning the effect of lime on soils, on plants, and the practice of liming. (88 pages).

Bulletin 108 (1904). *Classification of commercial fertilizers sold in Vermont.*—An arrangement of 123 brands sold in 1904 according to the amounts and character of their guaranteed plant food contents, made with a view of aiding the purchaser in his commercial choice.

Farm manures.—A classification and definition of the various forms of plant food; a review of Vermont's usage of plant food; a discussion of the chemical physical characteristics and of the wastes of manures and of their uses. (68 pages).

Bulletin 116 (1905). *How, when and what to use.*—A critical survey of systems of fertilization, of methods of application, of the sundry schemes suggested whereby some clue as to soil and crop needs may be gained, together with a very full series of fertilizer formulas for grasses, clovers, corn, cereals, roots, potatoes, vegetables, fruits, flowers and tobacco. (104 pages). (AVAILABLE ONLY AS A LOAN, SENT ON PROMISE IN ADVANCE TO RETURN IT WITHIN TWO WEEKS).

Bulletin 123 (1906). *Concerning the purchase of plant food.*—A discussion of methods of buying mixed goods and separate ingredients.

The moisture relations of the soil, especially as regards conservation and control of soil water, through irrigation, drainage, and particularly the sundry tillage operations. (68 pages).

Bulletin 130 (1907). *Soil biology in its relation to fertilization.*—A review of the relationship of soil organisms to soil usage, including statements as to microorganisms, their nature and classification; bacteria, their propagation and environment as to food, aeration, light, temperature, moisture and location, as to the prevalence of other forms, and as to the accumulation of their life products. Particular reference is made to soil bacteria affecting mineral ingredients in the dissolution of mineral plant food and to those affecting organic ingredients. Under the latter head is discussed decomposition in general, manurial decomposition in particular, nitrification, nitrogen fixation by bacteria in association with legumes, including nitrogen assimilation, and by bacteria unassociated with higher plants, including soil inoculation, also nitrogen elimination, including denitrification. The nitrogen cycle, and non-bacterial nitrogen losses are discussed and a balance struck of nitrogen gains against nitrogen losses. A partial list of literature consulted and a glossary are included. (144 pages).

Bulletin 135 (1908). *A quarter century of fertilizer inspection.*—A review by means of graphic charts and discussions thereof of trade value changes, guaranty maintenance, average analyses, selling prices, valuations, relative values, cost of plant food, the soluble nitrogen, available phosphoric acid and sulphate of potash usages, etc., etc., for each year from 1883 to 1908.

Soil deterioration and soil humus.—A discussion of the causes of soil deterioration, (erosion, nitrogen wastage, moisture conditions, soil texture, bacterial conditions, shortage of available plant food, and soil acidity, and lack of humus); of its benefits of humus to soil, (as a source of organic and inorganic plant food, as a means of water and warmth storage, as an improver of texture and an aid to microorganic growth); of the effects of a shortened supply of humus; of the effects of current agricultural methods (continuous cropping, inadequate rotations, fallowing, deforestation, forest fires, continued usage of commercial fertilizers); and of means for maintaining and of increasing the soil humus supplies (rotation, manuring and green manuring). (128 pages).

The remarks above outlined were written in 1902, 1903, 1904, 1905, 1906, 1907 and 1908; but they are just as applicable to the purchase and use of fertilizers in 1909 and succeeding years as they were when first penned. The reader of this circular who does not own a 93, a 99, a 108, a 123, a 130 or a 135, and wants either or all of them, has but to ask to receive. No. 116, being nearly exhausted, is only issued on loan to those who will promise to return it after it has served their purposes.

So far as possible in the writing of these treatises technicalities have been, are and will be avoided and plain every-day language used. Yet some topics, particularly that discussed in 130, are inevitably difficult to couch in simple yet accurate terms; hence many who read will find that careful attention will be needed. For the assistance of such, glossaries of definitions were supplied in bulletins 99 and 130. These glossaries will be added to from time to time in the future. Anyone failing to grasp the meaning of terms used should get 99 or 130 and make use of their glossaries. They are free for the asking. Each bulletin is thoroughly indexed and its contents made readily accessible.

Experiment Station,
Burlington, Vt.

Please mail me bulletins*..................................

Name ....

P. O. ....

State ....

*State numbers.

LIBRARY
OF THE
UNIVERSITY of ILLINOIS.

Vermont Agricultural Experiment Station

BURLINGTON, VT.

CIRCULAR No. 2

March, 1909

THE GYPSY AND BROWN TAIL MOTHS

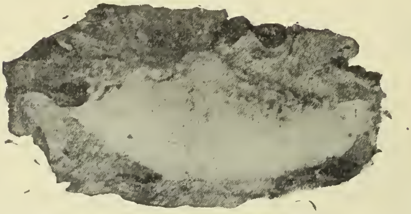
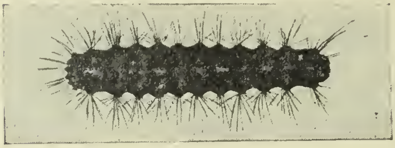
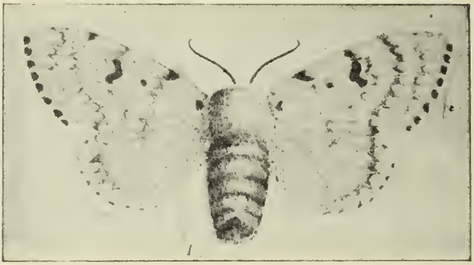
WM. STUART, HORTICULTURIST

The Gypsy and Brown Tail moths have spread from Massachusetts to New Hampshire and other New England States. Immense sums of money have already been spent in an attempt to prevent further devastation. These facts quite naturally have caused alarm in Vermont, especially near the Massachusetts and New Hampshire borders; alarm manifested during the last year or two by the large numbers of insects sent to the Station, believed to be either the Gypsy or the Brown Tail moth. In no instance were the fears of the sender warranted. The writer has no personal knowledge of their invasion of Vermont. How long this statement may hold true cannot be foretold; but it is clear that the chance of infestation increases with their greater spread. *The earlier the State is informed of their arrival, the easier, the less costly and the more certain their extermination. Hence the residents of counties bordering on Massachusetts or New Hampshire territory should be especially observant of all unfamiliar caterpillars or moths.* When doubt exists they should be at once forwarded to the Station for identification. The Station will at once notify the Commissioner of Agriculture if as a matter of fact the specimen sent is of either species[1]. It is suggested that inasmuch as the present incumbent of that office is not an entomologist specimens be submitted to the Station rather than to him, in the interests of saving time and obviating the necessity of their transshipment. Place name and

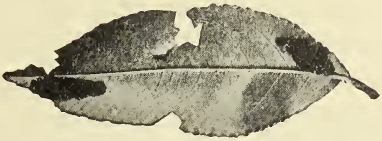
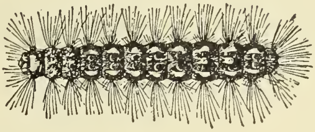
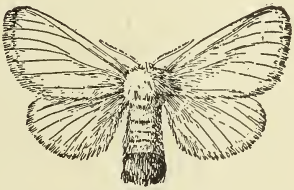
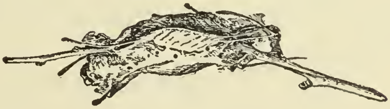
---

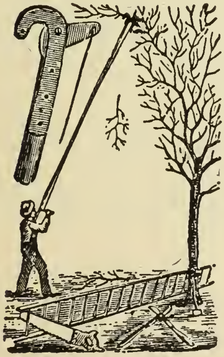
[1] Acts of 1908, No. 11, Sec. 8 (in part): Sec. 8. "Said commissioner may use such means as in his judgment are necessary to exterminate or prevent the introduction of the San Jose scale, the gypsy moth, the brown tail moth and any other threatening and unusual insect pest found to be injuring vegetable growth."

THE STAGES AND LIVES OF THE GYPSY MOTH

STAGES.	GYPSY MOTH.
EGG CLUSTER 	Usually on bark of tree, very rarely on leaf. Robust, 1½ to 2 inches long. Light yellow or creamy. From August to May.
CATERPILLAR. Full grown 	Dark grayish or sooty. Double row of five pairs of blue, followed by six pairs of red spots along back.
MOTH. Female 	Wings spread 2¼ in. Dingy-white, lightly streaked and blotched with blackish. No brush of brown hairs at tip of abdomen. Does not fly, crawls.
WINTER PASSED	In egg stage—see above. Never as a caterpillar.
IRRITATION OF HUMAN SKIN	Not caused by any stage.
MOST EFFECTIVE MEANS OF CONTROL. Soak eggs with creosote in fall, winter, or spring.	

AND BROWN-TAIL MOTH CONTRASTED.

Brown-Tail Moth.	Stages.
Always on under side of leaf. Smaller and more slender. Dark or golden brown. July.	Egg Cluster. 
Bright tawny or orange. A conspicuous row of pure white spots or dashes along each side of body. Only two bright red spots on middle line at lower end of back.	Caterpillar. 
Wings spread 1½ inches..... Pure snow white.	Moth, Female.
A conspicuous, sharply contrasted, thick tuft or patch of golden or brownish hairs at tip of abdomen. A swift, strong flyer, by night, and attracted to lights.	
As small caterpillars in a silken web or nest on tips of twigs, from which they crawl out in spring.	Winter Passed. 



IRRITATION.

Hairs from caterpillars, which are often transferred to cocoons and moths, cause an annoying and painful irritation of the skin.

Most Effective Means of Control.

Cut off and burn webs in winter.

postoffice address on packages. Specimens sent through the mail should be carefully enclosed in a package which is not easily broken or crushed, such as a wooden or tin box[1].

The food plants of these caterpillars in badly infested areas include the foliage of practically all deciduous trees. The Gypsy caterpillars usually attack forest and shade trees, while the Brown Tail prefers the foliage of the pear and apple.

The most marked difference in the life histories of these two insects, as noted in these illustrations[2], is shown in their winter habits. The Gypsy passes the winter in the egg, the Brown Tail as a young caterpillar. The distinct and characteristic markings of the full grown caterpillars and moths enable one to determine identities fairly well.

Methods of Distribution. The Brown Tail moth is best adapted by nature to spread over a wide area, for the female moth can fly to considerable distances, whereas the female Gypsy moth has very slight use of its wings. The usual methods whereby the latter are distributed are by the falling of the caterpillars onto passing vehicles (horse, automobile, trolley), they being thus borne considerable distances. The same means, of course, serve the Brown Tail as well.

Be on the watch for Gypsy and Brown Tail moths, especially in Windsor and Windham Counties, along the lower Connecticut River towns and the Massachusetts border.

Every New England State but Vermont now harbors these pests. The earlier they are combated, the shorter and more successful the battle.

Study the illustrations and descriptive matter and compare with specimens you may find.

Notify the Experiment Station, Burlington, Vt., if you think you have found either. Send specimens enclosed in a secure package, bearing name and address of sender.

---

[1] Sending insects by mail improperly packed is an offense against postal laws.

[2] Furnished through the courtesy of the New Hampshire Experiment Station.

Vermont Agricultural Experiment Station

BURLINGTON, VT.

CIRCULAR NUMBER 3

June, 1909

CONCERNING WORK WHICH THE STATION CAN AND CANNOT UNDERTAKE FOR RESIDENTS OF THE STATE

JOSEPH L. HILLS, DIRECTOR

Widespread misapprehension exists as to the functions of the Station. Many citizens think that inasmuch as they are taxpayers they may send all sorts of materials to the Station for free analysis and ask of it all sorts of service; and this despite the statement made yearly in the annual reports concerning what can and cannot be done. It is thought that perhaps the following somewhat elaborate and detailed statement may serve to correct these misunderstandings.

RELATIONS OF THE NATIONAL ENACTMENTS

The Experiment station is financed almost entirely by national funds. The national enactments of 1887 and 1906 do not contemplate the doing of any analytical work whatsoever for private individuals, either free or for a charge. The funds thus supplied are by the terms of the two laws, used "to conduct original researches or verify experiments" and "only (in) paying the necessary expenses of conducting original researches or experiments." By the terms of these acts the Secretary of Agriculture exercises a certain degree of supervision over their expenditures. The second or Adams act by its specific terms is placed under his direct administration. Moreover the close annual scrutiny of every voucher by the auditor representing the national department would preclude the use of these funds for anything but the purposes contemplated in the enactments, even if it were desired to make improper use thereof.

RELATIONS OF THE STATE LAW

Section 352 of the Public Statutes provides that the Station shall make "so far as time and means permit" free of charge to the residents of the State, analyses of "commercial fertilizers, home mixtures, fertilizer crude stock, soils, feeding stuffs, milk, butter, oleomargarine and other substitutes for butter, drinking water and other substances or products; provided that in (its) judgment such analyses will be for the public good." Section 4979 of the Public Statutes provides that under certain restrictions the Station shall make free of charge analyses of commercial fertilizers drawn by dealers at the request of buyers. When the law from which these two statutes were drawn was passed in 1886, it carried an annual appropriation of $3,500. This appropriation was withdrawn by the next General Assembly; but its duties and responsibilities remain to this day.

Strictly speaking the phraseology "other substances or products" covers the whole wide world; but the saving clauses "so far as time and means permit" and "provided that in (its) judgment such analyses will be for the public good" leave wide latitude of discretion with the Director. Strictly speaking, since the law carries no appropriation, and the national funds are unavailable, there are no " means." But inasmuch as the State has appropriated a thousand dollars annually for ten years for the printing of the report, and since the General Assembly of 1906 provided for state printing, an enactment which probably covers the printing of all station bulletins, in consideration thereof a not over large usage of station time and funds for these purposes is allowed.

Moreover during the past twenty-two years things have changed. New legislation has been enacted, other agencies for the public service have been instituted and experience has been gained. To the State Board of Health laboratory established in 1898 by state law are now assigned the analyses of drinking water and of human foods. Hence all "butter, oleomargarine, and other substitutes for butter and drinking waters" should be sent to that laboratory.

FREE ANALYTICAL WORK

The materials named in paragraphs numbered 1 to 10 on pages 3 and 4, whether mentioned in the Public Statutes or not, are handled without charge to residents of the State, if received not too frequently from one individual, provided:

(a). The work appears to be of public benefit and the results are at the disposal of the Station to publish if it deems advisable.

(b). The samples are taken in accordance with directions formulated and furnished by the Station.

(c). The carriage charges are prepaid.

(d). It is physically possible to do the work within a reasonable time and without serious interruption to regular and stated duties.

During March, April and May such samples, other than those of milk and its products, as require chemical analysis are commonly held unanalyzed and are handled in June and July in the order of receipt. This delay is necessarily caused by the fact that the chemical laboratory force during these months is engaged in fertilizer control work from which it cannot be diverted for this semi-private work. When, however, an association of farmers makes contracts for feeds or fertilizers in carloads lots or more, basing their purchases upon a definite guaranty the maintenance of which is a precedent to full payments, exception is made to this rule and analyses are made as promptly as practicable.

1. *Commercial fertilizers,* licensed or unlicensed, or the crude stock thereof.

Usually requests for the analyses of regular licensed fertilizers are comparatively few in number. They ordinarily call simply for a duplication of the work which is already done or ready to be done on the regular and officially taken samples. When practicable, and when it is possible thus to meet the views of the party sending the sample, the analyses of such regular and official samples are furnished since the results are more apt to be truly representative. It is more difficult than is commonly appreciated to take a thoroughly accurate sample of a commercial fertilizer.

2. *Feeding stuffs* for domestic animals; for protein only—unless for special reasons the determination of other nutrients is desired,—and for weed seeds—if desired.

If in the purchase of a feed or fertilizer doubt arises in a buyer's mind as to its adulteration or misbranding, or if illegal or unknown brands are offered, and the facts are submitted to the Station, an official sample will be taken if practicable, provided the statements made seem to warrant such a procedure. The results of the analyses of samples thus taken will be sent without charge to the party furnishing the data.

3. *Milk, skimmilk, cream,* etc. (if sent in quantities of not less than four ounces in filled, wide mouth bottles, and in number not to exceed four samples annually from any one individual or company. This limit may be curtailed at the discretion of the Station but may not be increased save in special cases). The reason for the restriction as to numbers of samples of this character handled is obvious. The state law providing for free analyses was passed in 1886, prior to the invention of the Babcock test. It did not contemplate the station's doing for an individual that which he can readily do for himself. The Babcock test is to be found in every dairy community in Vermont. Anyone of ordinary intelligence and careful manipulation can learn to run it. For the Station to do free, wholesale, private testing of dairy products under the provisions of a law passed before such conditions obtained, and one moreover which makes no direct provision for the expenses incurred, were obviously unnecessary. The Station is not in the market to do wholesale work of this character, either free or for a charge, for individuals, creameries or cheese factories; but as is remarked in the text does handle samples in small numbers.

4. *Maple products* (as to genuineness but not as to quality).

5. *Natural deposits of material or manufactured products having supposed fertilizing value* (peats, mucks, marls, ashes, lime, etc.).

6. *Agricultural seeds,* as to purity. If germination tests are desired the samples, if in too large numbers, may be declined or else submitted to the Seed Division of the National Department of Agriculture.

7. *Fruits, grasses, weeds, and other plants* (identified as to name, value or worthlessness, and as to methods of propagation or eradication).

8. *Fungous diseases* (identified, methods of combat indicated).

9. *Insect pests* (identified, methods of combat indicated).

10. *Other materials strictly agricultural in their origin and usage, other than such as are excepted in the following list:*

LIST OF MATERIALS NOT ANALYSED

The Station does no analytical work whatsover for charge. Materials which, either because of their character or because of lack of time or means, cannot be handled by the Station without charge should be submitted to private analysts.

The following materials can neither be analyzed nor otherwise handled, but should be sent to the places mentioned:

1. *Drinking water.* (Samples should be sent to the State Board of Health Laboratory, Burlington, Vt. This laboratory should be notified prior to forwarding the sample that it may send directions for sampling.)

2. *Human food including liquors.* (Ditto).

3. *Drugs.* (Ditto).

4. *Poisons and cases of suspected poisoning,* whether animal or human. (Ditto.)

5. *Minerals.* (Samples should be sent to State Geologist, Burlington, Vt.)

6. *Materials of an agricultural character received from nonresidents.*

7. *Soil.*

Notwithstanding the fact that this strictly agricultural material is specifically mentioned in the Statutes as a proper one to send to the Station for free analysis, it cannot be handled for the following reasons:

It is a common notion on the part of farmers that a chemist can tell by analysis just what a soil needs, and prescribe just how that soil should be fertilized to attain the best results. This notion, however, is erroneous, at any rate so far as it relates to the East. Chemists can analyze the virgin soils of the West, for instance, and the analyses may mean something, but it does not with eastern soils.

There are several reasons why soil analysis is not helpful. In the first place it is difficult for the farmer to take a sample which means anything. Soil samples taken three feet apart in the same field often analyze quite differently, and the question arises which is right, if either. Then, again, inasmuch as most eastern soils, other than sod land freshly broken, have been fertilized more or less and because a considerable proportion of the manurial constituents thus added are not used up but are unevenly distributed, other sources of errors are introduced. Moreover no chemist cannot distinguish with any degree of certainty between plant food which is available this year and that which may not be available for a hundred years to come. The total content of each ingredient is determinable, but not its availability. A soil may be literally loaded with plant food which owing to its insolubility the crop cannot use. Furthermore crop failures may be due to causes other than the lack of plant food; such, for instance, as soil acidity, lack of humus, inadequate tillage, faulty drainage, etc. Soil analysis may disclose a relative lack of plant food, or the presence of some deleterious matter; but further than this at present it cannot go, popular notions to the contrary notwithstanding.

It is the quite universal custom among eastern stations to suggest as feasible means of gaining some insight into soil needs, the use of litmus paper to determine acidity; the growth of a half limed, half unlimed row of beets for the same purpose; the observation of the characteristics of crops—as to color of foliage, strength of stalk, sourness, etc., the nature of the natural herbage; and especially the making of experimental trials using diverse forms of plant food as outlined in bulletin 116, pages 174-177 (available as a loan only).

COUNSEL AND ADVICE BY CORRESPONDENCE

The Station advises and assists by correspondence in matters pertaining to agriculture, horticulture, plant and animal disease, insect injury, etc. The station horticulturist, acting as State Nursery Inspector, inspects nursery establishments. The Station Forester, acting as State Forester, advises as to the planting, management and care of woodlands. Under the provisions of the state laws the expenses incurred by these two officials in such work are paid by the applicants.

VISITATIONS

Visitations by specified members of the station staff are sometimes requested to private farms, orchards, dairies, creameries or cheese factories for the purpose of affording expert advice as to their adequate conduct as business operations. Such requests are always made in thorough good faith and quite commonly are accompanied by a proffer to pay the expenses incurred. Yet they are requests which cannot be considered,[1] and which are made under a misapprehension of the station's proper functions, to say nothing of the over-estimates of the abilities of the several members of the station staff. These gentlemen do not set themselves up to be expert managers of these several sorts of farm operations, although most of them were farm raised. Their particular function in life, so far as relates to their experiment station work, is to attempt to solve problems bearing upon agricultural operations. The giving of advice on general matters or upon specific points touching farm operations by correspondence or in consultation at the Station is an everyday affair with them. It is a service which is gladly rendered whenever the questions are so clearly and definitely stated as to admit of adequate answer. But they cannot attempt to adjust the knowledge gained by station work or otherwise, or the advice or suggestions proffered as the result of such knowledge, to local conditions or to the running of a given farm or other agricultural business operation. This is the particular province of its operator and not of a supposed expert.

---

[1] Save by the State Forester. See last paragraph on page 5.

Vermont Agricultural Experiment Station

BURLINGTON, VT.

CIRCULAR NUMBER 4

January, 1910

FOREST NURSERY STOCK FOR DISTRIBUTION IN THE SPRING OF 1910

FOREST SERVICE PUBLICATION NO. 3.

A. F. HAWES, STATE FORESTER.

The Vermont State Forest Nursery was established by act of Legislature for the purpose of raising forest seedlings to be sold at cost price to land owners in the State. A good beginning on a small scale was made with the $500 appropriation. The General Assembly of 1908 in creating the office of State Forester gave him authority to expend a portion of the funds appropriated to his use for nursery purposes. This has enabled a considerable enlargement of the nursery, so that within two years a large supply of stock will be available for distribution.

The demand last spring (1909) so far exceeded the supply that 350,000 white pines were imported from Europe, no American nurserymen being able to make equal prices. The Massachusetts, Connecticut, and New York State Forest Services pursued a similar course. These were in part distributed about the State. While planting was going on in New York, it was discovered that some of these imported seedlings were infested with a common European fungus disease, the White Pine Blister (*Peridermium Strobi*), entirely different from the pine blight and not heretofore discovered on American pines. A careful examination showed some indication of the disease on a few of the Vermont imported seedlings, but not until the coming spring (1910) will it be possible to tell its extent. Fortunately it is a comparatively easy task to eradicate this malady since its spores must spend part of their life on the currant or gooseberry bush. As soon as it was discovered that there was a chance that this disease might exist on the imported nursery stock, a careful examination was made of every plantation thereof throughout the state, and all currant and gooseberry bushes, whether wild or cultivated, within 500 feet were destroyed.

The unsold European white pine stock was placed in the nursery and is now offered under special arrangement for the spring of 1910. It will be sold only in large lots, so that inspection may be made easily, and only to land owners who can satisfy the State forester that no currant or gooseberry bushes grow on or near their premises. Sand plain land is most apt to be free of these plants, and it is hoped that all of this stock may be used on that kind of soil. The trees are four years old, very sturdy, and, save for the possibility of disease would be specially recommended. They are not included in the following list. No more will be imported, and as there are no three-year-old seedlings on the American market at reasonable prices, the only white pines for sale in 1910 will be two-year-olds.

PRICES OF SEEDLINGS PER THOUSAND, SPRING OF 1910

White pine, 2 year seedlings	$ 3.25
Scotch pine, 2 year seedlings	3.25
Scotch pine, 3 year transplants	5.00
Norway spruce, 2 year seedlings	3.00
Norway spruce, 3 year seedlings	3.50
Norway spruce, 4 year transplants	9.00
Black or Yellow locust, 1 year seedlings	2.00

Seedlings and transplants are sent *express collect.* When sent in baskets a charge is made of $1 per basket. (A basket holds about 5,000 two year old pines). If, however, these baskets are at once returned, express prepaid, with name of shipper affixed for identification, the charge will be deducted. All orders will be filled in the order of receipt. No order for less than *1000* nor more than *20,000* of any one kind will be filled. These trees are sold for forestry purposes, and are to be planted solely within the State. Bills will accompany shipments. *Postage stamps will not be accepted in payment.*

solely within the State. Bills will accompany shipments. *Post-*

SELECTION OF STOCK

Black or Yellow locust makes a good tree for fence posts, railroad ties, etc., but should only be planted on good soil, since it is more apt to be attacked by the locust borer on sandy soils.

Norway spruce resembles the native spruce, save that it grows more rapidly, and, if anything, makes a more valuable lumber. It is adapted for planting on any good forest soil other than sandy soils and especially in the mountains.

White pine is suited to any Vermont soil. It is on the whole the best tree for forest planting, because it grows rapidly, makes the most valuable timber and produces the largest crop.

Scotch pine resembles white pine, and will thrive on dryer sands or wetter swamps; in other words, it is even less fastidious. It grows more rapidly in youth, but the timber is less valuable.

AGE OF STOCK

Three or four year old stock is preferable for pines. Two year seedlings can be advised only for land that is free from brush and strong grass growth. On old pastures they are nearly as satisfactory as is older stock. If it is intended to plant land which is much grown up to brush, it is advised that two year seedlings be set out in the garden for a year prior to transplantation into the permanent site. They should be set in the garden about three inches apart, in rows that are a foot or more apart, and, while in these nursery rows, should be kept carefully cultivated. Two year old spruces should never be set out in the permanent site, but always in nursery rows for a year as described above. One year locusts are from one to three feet high and are quite large enough for permanent planting.

DIRECTIONS FOR PLANTING

Time of planting. The sooner the planting is done after the frost is out of the ground in the spring the better. Evergreens should not be transplanted late in the season, after they have begun to grow, unless it is late in the fall. In Vermont the best season is usually from April 15 to June 1.

Unpacking stock. The seedlings should be planted as soon as possible after arrival. If they cannot be planted at once, they should be heeled in, near the site that is to be planted. A ditch, preferably under shade, may be dug, and, after the bundles are untied, the roots should be covered with earth in this ditch, shading artificially if necessary.

Puddling. Just before planting a thick mud should be made, preferably with clay. A few hundred trees are taken from the box or ditch and their roots dipped in this mud. These are then placed in a basket or pail and their roots covered with wet moss or cloth.

Spacing. Dense planting is desirable so that the trees will automatically prune their lower limbs. They will thus make a better height growth than if wide spaced. After the lower limbs are killed the trees should be thinned. Planting 6x6 feet gives 1200 trees per acre; 5x6 feet gives 1500 trees per acre.

Planting. The mattock or grub hoe is the best planting tool. The sod is first scraped away, then the mattock blade buried and the handle twisted to the right, making a hole at the side of the blade. The seedling is then inserted before removing the blade, and, after removing the mattock, the soil is pressed with the foot firmly about the roots of the seedling, leaving it in an upright position. Care should be taken not to let the roots dry out. Five minutes exposure is often enough to kill them.

Crew. Four men can work to best advantage, three men with mattocks, each following a straight line across the field, these lines kept approximately 6 feet apart, while a fourth man or boy carries the trees in a basket or pail strapped over his shoulder, and passes them out to the other three. Such a crew can plant from 2000 to 4000 trees a day according to the kind of land.

Cost. The cost varies with the kind of trees used and the character of the land. Allowing 1200 trees per acre, the total cost varies from $6 to $10.20 per acre. (1200 2 year olds @ $3.25 = $3.90; planting @ $1.75 per 1000 = $2.10. 1200 3 year olds @ $5 = $6.00; planting @ $3.50 per 1000 = $4.20). The larger the area planted, the cheaper the rate per acre.

SUCCESS OF PLANTING

The percentage of trees which live depends largely upon the care taken in planting and upon the weather conditions prevailing for the first two months after planting. When circumstances favor many plantations have passed through the first year with a loss of less than 5 percent. If carelessly planted, or if a drought occurs during the spring, the loss may exceed 15 percent. Usually very slight loss occurs after the first spring.

Subsequent treatment. Plantations must be protected from fire and grazing. Cattle break off the tops of the seedlings rubbing against them, and must therefore be excluded. No cultivation, watering or fertilization is needed. Pruning of the live limbs should not be practised. The plantation will require but little treatment for the first fifteen or twenty years.

Vermont Agricultural Experiment Station

BURLINGTON, VT.

CIRCULAR NUMBER 5

January, 1910

CONCERNING BULLETINS 145, 147, 148 and 150.

The Experiment Station not infrequently publishes bulletins which are so technical in their character that they are ill adapted to popular reading. To send such to all the addresses on its regular mailing list would be a waste, for few farmers would read them. Yet such publications must needs be made, as the Station is primarily an institution for research.

Inasmuch as it is now issuing four bulletins, which it does not expect to send to its entire mailing list, this explanatory circular is offered, briefly describing these bulletins. *Anyone who does not receive but desires to receive any one or all of them, has but to state his desires and they will be promptly met and without charge.*

NO. 145. VERMONT SHRUBS AND WOODY VINES

A 150 page, beautifully illustrated monograph, descriptive of the indigenous shrubs and woody vines of Vermont, together with a carefully worked out key, enabling one with but little knowledge of botany to determine the identity of a shrub or vine. A great deal of painstaking labor has been put upon this bulletin by the writers (the station botanist, Prof. L. R. Jones, and Mr. F. V. Rand, B. S., 1908) and the artist, (Miss Mary Robinson of the class of 1909) and it is thought to be unique among eastern station publications. It has been issued especially for use in the public schools of Vermont, and has already been quite freely distributed to the schools.

NO 147. THE BACTERIAL SOFT ROTS OF CERTAIN VEGETABLES

A 120 page bulletin, issued in cooperation with the New York (State) Experiment Station, dealing with the divers soft rot organisms and their enzyms. The studies on which this bulletin are based were begun ten years ago. No. 147

is a strictly technical publication, of use mainly in clearing up matters touching the nature of these soft rots. The authors are: On the part of the New York Station, Mr. H. A. Harding; on the part of the Vermont Station, Messrs. L. R. Jones and W. J. Morse (now of the Maine Station).

NO. 148. A SOFT ROT OF THE MUSKMELON CAUSED BY BACILLUS MELONIS, N. SP.

A technical bulletin, 56 pages long, describing a new species of bacterium, which was found devastating a melon patch in St. Albans in the fall of 1908, by N. J. Giddings, formerly assistant botanist of the Vermont Station and now bacteriologist of the West Virginia Station.

NO. 150. THE ROLE OF ANESTHETICS AND OTHER AGENTS IN PLANT FORCING

A technical bulletin, about 40 pages long, dealing with the effect of ether and other anesthetics in plant life, by Prof. Wm. Stuart, formerly horticulturist of the Station and now connected with the United States Department of Agriculture.

Vermont Agricultural Experiment Station
BURLINGTON, VT.

CIRCULAR NUMBER 6

January, 1911

FOREST NURSERY STOCK FOR DISTRIBUTION IN THE SPRING OF 1911

Forest Service Publication No. 5

A. F. Hawes, State Forester

Part I

The popularity of the State nursery has far surpassed the hopes of its original promoters and it has already become one of the chief agents in the forestry education of the state.

The number of trees sold in 1909 was 195,500; in 1910, 376,700. So great has been the demand for nursery stock that it has not yet been possible to hold over a sufficient number of two year seedlings to produce three-year-olds, which is the age of stock most recommended; and orders for about 50,000 trees had to be refused in the spring of 1910.

KINDS OF TREES RECOMMENDED

There are various types of lands in Vermont which should be planted to forest trees, as they would be more profitable when producing timber than when handled in any other way.

White pine.—For most of this land the white pine is the most profitable tree that can be planted. While it thrives well on a dry sandy soil, it grows even better on a loam. After it is once started it will grow from one to two feet in height a year for forty to fifty years. It is perhaps unsafe to plant it at elevations exceeding 1800 feet in the southern or 1500 feet in the northern part of the State. Near these limits of elevation a southern exposure is safer than is one facing north.

Scotch pine.—There are in certain portions of the State, notably in the Passumpsic valley near Lyndonville and in Castleton, Rutland county, areas of shifting sands. One of the approved ways of checking such encroachings is to plant the areas with some forest tree. The Scotch pine is even better adapted for these extremely dry situations than is the white pine. Furthermore it makes a more rapid growth than does the latter, at least for the first thirty years. The height growth on fair soil is often three feet a year.

Norway spruce.[1]—For the abandoned pastures at high elevations and especially for the hill tops and mountain slopes from which spruce has been cleared, the planting of Norway spruce is recommended. Spruce should not be planted on sandy land.

Black or yellow locust makes a good tree for fence posts, railroad ties, etc., but should only be planted on good soil, since it is more apt to be attacked by the locust borer on sandy soils.

Seedling versus planting.—Inquiries are frequently received as to the advisability of sowing pine seed. Experiments in this country and abroad have demonstrated thoroughly that satisfactory results cannot be expected if seed is sown on unprepared land, but may sometimes be obtained by plowing furrows five or six feet apart and sowing the seed in these furrows at the rate of two pounds or more per acre. A better method yet is to plow and harrow the land and to sow it broadcast to buckwheat and to at least two pounds of pine seed. Either of these methods is nearly as expensive as is planting and is much less satisfactory. Furthermore, it is impracticable for most of the land where forest planting is desired.

PRICES OF NURSERY STOCK PER THOUSAND, SPRING 1911

White pine 2 year seedlings[2]	$3.10
White pine 3 year transplants[2]	5.00
Scotch pine 2 year seedlings	3.10
Scotch pine 3 year transplants	4.75
Scotch pine 4 year transplants	7.00
Black locust 1 year seedlings	2.00
Black locust 2 year seedlings	7.00

---

[1] Unfortunately the small supply of this stock available for this year is already engaged.

[2] Seedlings are raised in the seed beds two years and are then transplanted. A year after this transplanting they are called three year transplants.

Transportation.—The prices given above are for stock packed at the nursery, ready for shipment. All transportation charges are borne by the purchaser. When sent in baskets a charge is made of $1 per basket (a basket holds about 5,000 two-year-old pines). If, however, these baskets are at once returned, express prepaid, with name of shipper affixed for identification, the charge will be deducted. An idea of the cost of transportation may be obtained from the following figures of last year's shipments.

40,000 3 year and 4 year transplants of white pine, weight 2 tons, express charges Burlington to Springfield, Vt., $27. Cost per thousand, 67 cents.

12,000 2 year seedlings of white pine, express charges New Haven, Conn., to Milton, Vt., $2.75. Cost per thousand, 23 cents.

15,000 4 year transplants of white pine, weight 1,500 pounds (100 pounds per 1,000 trees packed), express charges Burlington to Plainfield, $7.30. Cost per thousand, 48 cents.

35,000 3 year and 4 year transplants of pine and spruce, freight charges Burlington to Sharon, $13. Cost per thousand, 37 cents.

From the above it will be seen that the express charge on two year seedlings is less than half of that on three year transplants; also that the freight charges on transplants from Burlington to Sharon were 30 cents per thousand less than the express charges on similar stock from Burlington to Springfield, Vt., a distance of about fifty miles more.

In the future, unless otherwise directed by the purchaser, all orders of coniferous seedlings not over two years old, and orders of less than 10,000 three or four-year-olds, will be shipped by express. All orders of 10,000 or more three or four year coniferous transplants will be shipped by freight.

Limit of orders.—No order for less than 1,000 nor more than 20,000 of any one kind will be filled. These trees are sold for forestry purposes and are to be planted solely within the State.

Payments.—Bills will accompany shipments. *Postage stamps will not be accepted in payment.*

DIRECTIONS FOR PLANTING

Time of planting.—The sooner the planting is done after the frost is out of the ground in the spring the better. Evergreens should not be transplanted late in the season, after they have begun to grow, unless it is late in the fall. In Vermont the best season is usually from April 15 to June 1.

Unpacking stock.—The seedlings should be planted as soon as possible after arrival. If they cannot be planted at once, they should be heeled in, near the site that is to be planted. A ditch, preferably under shade, may be dug, and, after the bundles are untied, the roots should be covered with earth in this ditch, shading artificially if necessary.

Puddling.—Just before planting a thick mud should be made, preferably with clay. A few hundred trees are taken from the box or ditch and their roots dipped in this mud. These are then placed in a basket or pail and their roots covered with wet moss or cloth.

Spacing.—Dense planting is desirable so that the trees will automatically prune their lower limbs. They will thus make a better height growth than if wide spaced. After the lower limbs are killed the trees should be thinned. Planting 6x6 feet gives 1200 trees per acre; 5x6 feet gives 1500 trees per acre.

Planting.—The mattock or grub hoe is the best planting tool. The sod is first scraped away, then the mattock blade buried and the handle twisted to the right, making a hole at the side of the blade. The seedling is then inserted before removing the blade, and, after removing the mattock, the soil is pressed with the foot firmly about the roots of the seedling, leaving it in an upright position. Care should be taken not to let the roots dry out. Five minutes' exposure is often enough to kill them.

Crew.—Four men can work to best advantage, three men with mattocks, each following a straight line across the field, these lines kept approximately 6 feet apart, while a fourth man or boy carries the trees in a basket or pail strapped over his shoulder, and passes them out to the other three. Such a crew can plant from 2000 to 4000 trees a day, according to the kind of land.

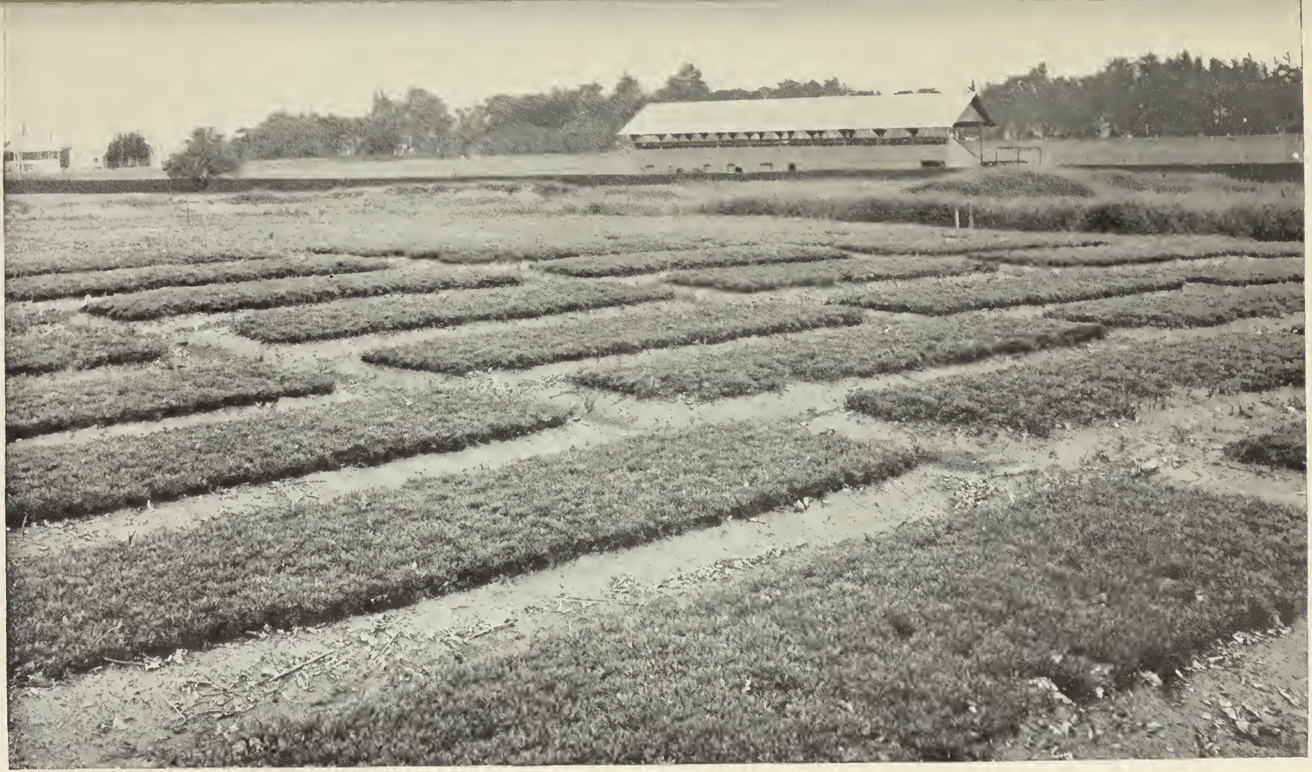


PLATE I

Seed beds of white pine in state nursery, Burlington.

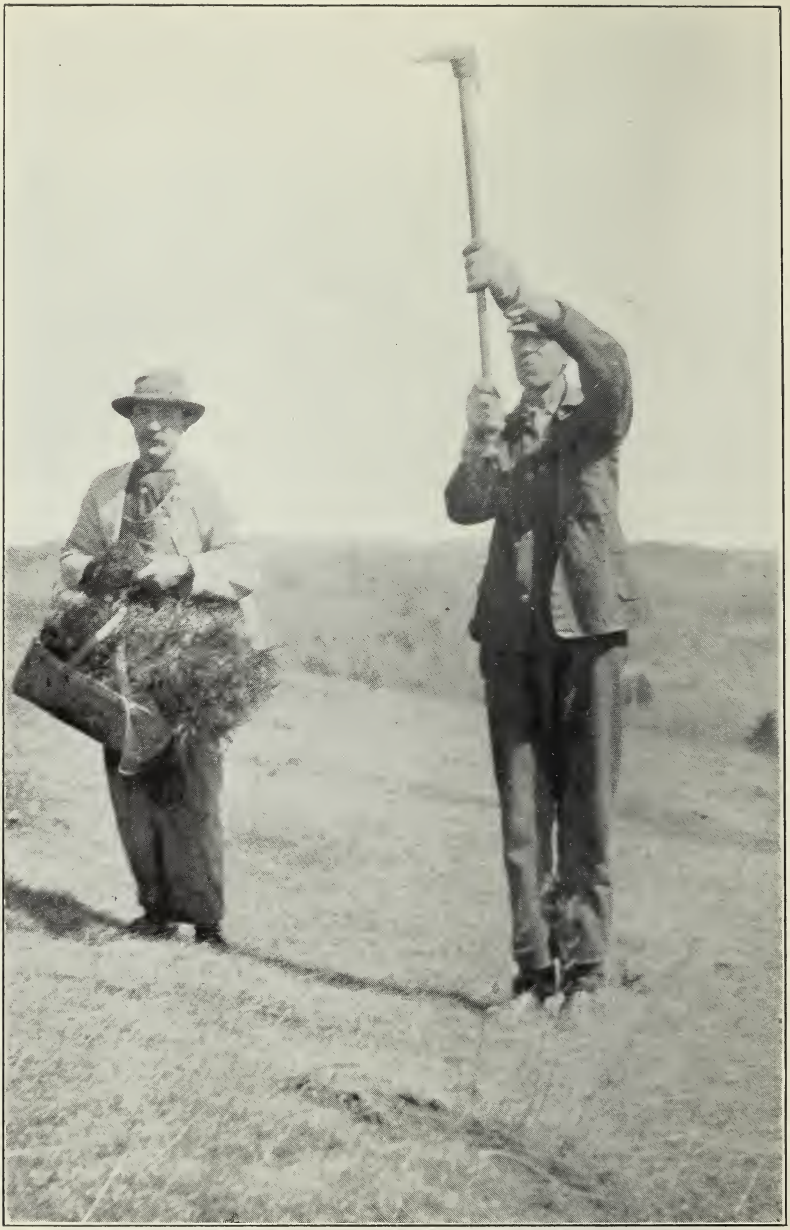


PLATE II
Method of planting seedlings with mattock.

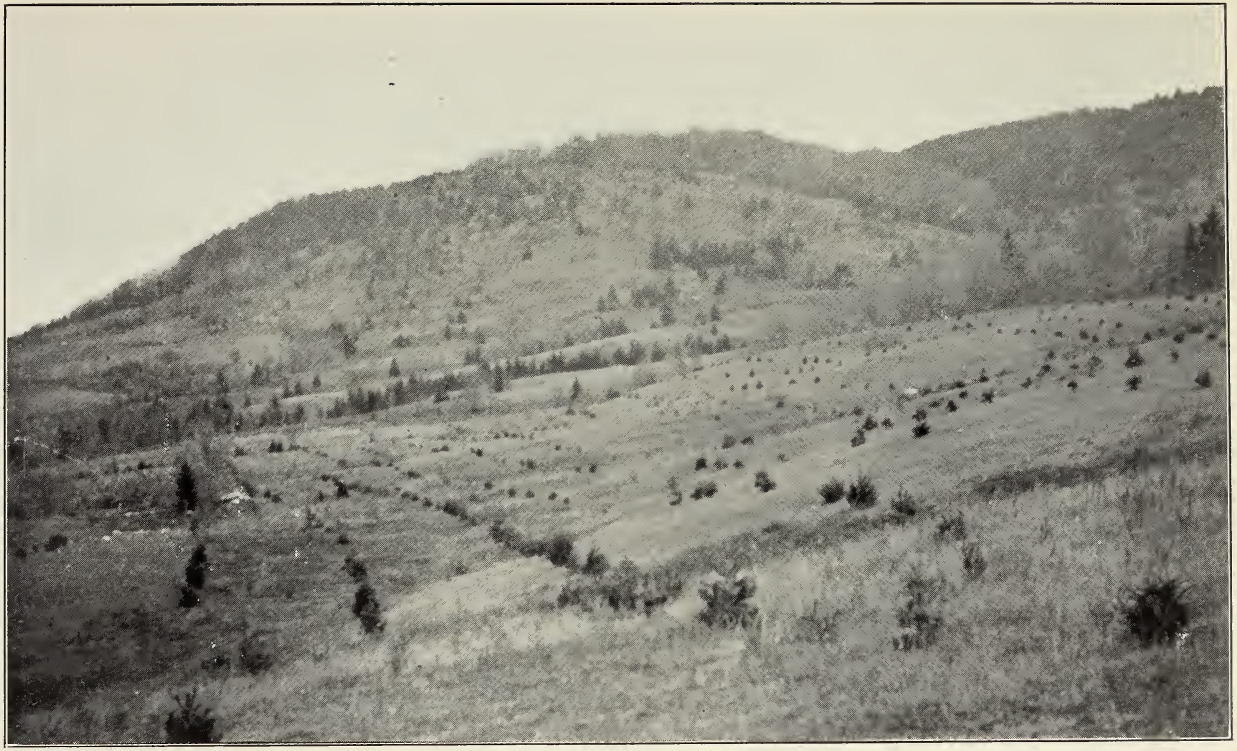


PLATE III

Pine plantation in Windham, Vermont. Five years after planting. Trees too far apart.

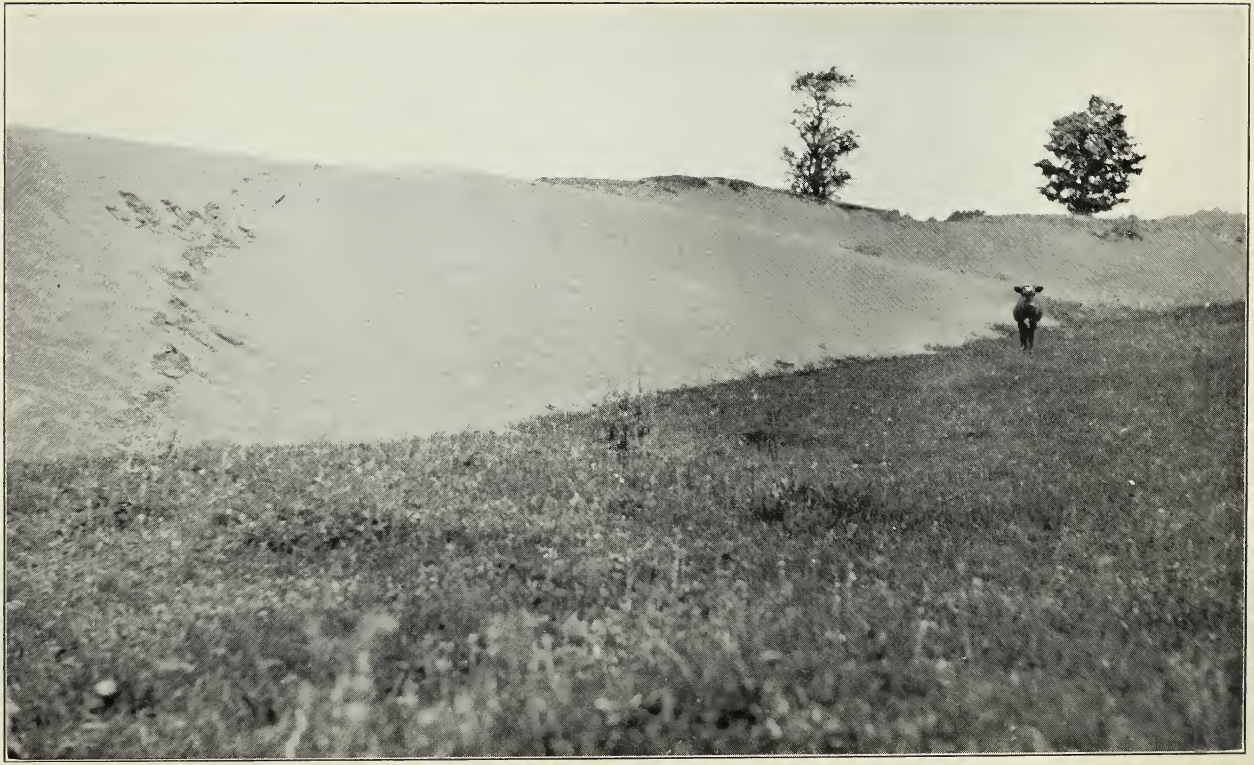


PLATE IV
A sand dune encroaching on farm lands in Castleton, Vt., which should be checked by forest planting.

COST OF PLANTING

On one day seven men planted on the state forest in Plainfield between 7,000 and 8,000 trees, i. e., an average of slightly over 1,000 trees per man a day.

In four days nine men planted on the state forest in Sharon 34,000 trees, i. e., an average of slightly less than 1,000 trees per man a day. These figures illustrate about the maximum rate of planting, for in both cases the land was free from rocks and brush and the men could work rapidly.

With labor at $1.50 per day the cost of planting is as follows:

	Per 1000	Per 1200	Per 1500
Planting 500 trees per day per man......	$3.00	$3.60	$4.50
“ 600 “ “ “ “ “	2.55	3.06	3.82
“ 700 “ “ “ “ “	2.10	2.52	3.15
“ 800 “ “ “ “ “	1.87	2.24	2.80
“ 900 “ “ “ “ “	1.65	1.98	2.48
“ 1000 “ “ “ “ “	1.50	1.80	2.25

Considering the average railroad transportation charges as 30 cents per thousand and the cost of hauling from the railroad to the land 10 cents per thousand, the cost of planting various kinds of land is as follows:

Example 1. Using white pine 2 year seedlings at $3.10.

	6′ x 7′ = 1000 Trees per acre		6′ x 6′ = 1200 Trees per acre	
	Rough land	Easy land	Rough land	Easy land
Trees	$3.10	$3.10	$3.72	$3.72
Transportation	.40	.40	.48	.48
Planting	3.00	1.50	3.60	1.80
Total cost per acre	$6.50	$5.00	$7.80	$6.00

Example 2. Using white pine 3 year transplants at $5.00.

	6′ x 6′ = 1200 Trees per acre		5′ x 6′ = 1500 Trees per acre	
	Rough land	Easy land	Rough land	Easy land
Trees	$6.00	$6.00	$7.50	$7.50
Transportation	.48	.48	.60	.60
Planting	3.60	1.80	4.50	2.25
Total cost per acre........	$10.08	$8.28	$12.60	$10.35

Example 3. Using Scotch pine 4 year transplants at $7.00.

	6′ x 7′ = 1000 Trees per acre		5′ x 6′ = 1500 Trees per acre	
	Rough land	Easy land	Rough land	Easy land
Trees	$7.00	$7.00	$10.50	$10.50
Transportation	.40	.40	.60	.60
Planting	3.00	1.50	4.50	2.25
Total cost per acre	$10.40	$8.90	$15.60	$13.35

From the above examples it will be seen that the cost of planting an acre may vary from $5.00 for planting 1000 2 year trees on easy land to $15.60 for planting 1500 4 year transplants on brushy, rocky land.

Success of plantations.—The results of private planting and of that done on the two state forests indicate that with good weather conditions it is safe to expect the following results at the end of the first year:

White pine.	*Percentage alive at end of first growing season.*
Transplants, 3 or 4 years	85 to 98%
Seedlings, 2 years	75 to 90%
Woods grown stock	60 to 80%

Age of stock.—While the two year seedlings may thrive as well on light pasture where there is little grass growth as the three year transplants do on land covered with brush, the advantage on the same class of land is always with the transplants. Two year seedlings of spruce should never be planted in permanent site. One year locusts are from one to three feet high and are large enough for permanent planting.

PART II

PRIVATE NURSERIES

The raising of evergreen seedlings from seed is a business that requires considerable experience and a great deal of attention. For these reasons we believe that the state nursery can raise better stock and at a lower price than can most private parties. We do not, therefore, recommend the raising of nursery stock from seed.

There is, however, a phase of the nursery business which the private party can do successfully and advantageously to himself. This is the transplanting of seedlings into a private nursery. The chief advantage obtained by doing this is that the purchaser can thus be assured of a future supply of transplants and that they will be near at hand so that he can use them when he wishes.

Special offer.—The transplanting work has to be done in a short period of about six weeks just after the frost is out of the ground. During this same period the state nursery will be obliged to pack and ship about one-half million trees. If it succeeds in transplanting an equal number a large force of green men will be required, and it is difficult to organize such a force to work economically for such a short period. Crowding immediately on this comes the seed bed work which is now assuming very large proportions. For these reasons we are anxious to have the people of the State do some of this work of transplanting which can be done just as well, after a little practice, by any farmer. The mere work of counting out the stock costs considerable. The writer figured last spring that the average cost for taking up, counting, bundling, puddling, and packing trees of all ages was 55 cents per thousand. At least 10 cents of this charge is justly debited against the counting. In order to encourage private transplanting, the state nursery will furnish for this purpose two year white pine seedlings at $3 per thousand in quantities ranging from 10,000 to 20,000 on the understanding that the exact number is not guaranteed. The average weight per thousand of these seedlings will be ascertained and they will be counted by weight. In many cases the number will overrun; if it is less it will indicate that the trees are better developed than the average. In this way there will be a saving of $1 on every 10,000 trees.

Transplanting.—A good garden spot with a loam soil is the best place for transplanting. Unless the soil is already enriched, a fertilizer of manure or bone meal is desirable. The former should be plowed in, while the latter may be harrowed in or applied on top. When the soil is thoroughly fined the seedlings are put in in rows eight inches or a foot apart. The latter allows the use of a hand cultivator. The trees are spaced about two inches apart in the rows. The rows should be made straight with a string and a trench dug about six inches deep, perpendicular on the string edge, with a straight edge spade. The trees are held against the perpendicular wall of the trench and the earth is replaced and packed firmly against the roots. Care should be taken not to bury any of the needles.

During the past year we have used to facilitate this transplanting the Yale Planting Board. This is an ingenious device for holding forty or fifty trees in an upright position in the ditch while the earth is replaced. Two men are kept busy digging the ditch and replacing the earth, and two others fill the boards with trees. Two boards can thus be used to best advantage. The average cost of transplanting in the state nursery with the use of these boards, was $1.10 per thousand. The fertilizer, and labor in weeding and cultivating during the year amount to between 80 and 90 cents per thousand, making the difference in cost between $3.00 for 2 year seedlings and $5.00 for 3 year transplants.

Subsequent treatment.—The only care needed by these trees is to keep them well weeded and cultivated. No watering is necessary and no protection during the winter is necessary. They can be taken out and planted in the final site according to directions in the first part of this circular, the spring after transplanting, or they may be kept in the nursery two years—but not longer.

5-9c

OF THE
UNIVERSITY OF ILLINOIS

Vermont Agricultural Experiment Station

BURLINGTON, VT.

CIRCULAR NUMBER 7

March, 1911

PLANT FOOD COMBINATIONS FOR SUNDRY CROPS

By J. L. Hills

Bulletin 116, containing data as to how, when and what to use in the line of commercial fertilizers, has for a long time been nearly out of print. The few remaining copies have become nearly worn out by frequent travels through the mails as loans. The very large calls for the information conveyed by certain portions of this bulletin, and the inability under these circumstances of meeting this call in a satisfactory manner, impel the reprint of those portions of most interest in the form of this circular.

The formulas have been worked over and expressed always in terms of MIXTURES FOR FOUR ACRES, and in terms of EVEN HUNDREDS OF POUNDS, so as to simplify the matter of weights. Crude stock is shipped commonly in bags weighing either 100, 200 or 224 pounds. Obviously if one is to plant but 1, 2 or 3 acres, or more than 4 acres, one can calculate accordingly as to mixtures and amounts. Furthermore, if one does not care to use the full amounts indicated he can scale downward as he sees fit. The amounts prescribed will doubtless seem large to many farmers, but are not larger than are in common use by successful users of commercial goods. When one considers the relatively small proportion of the total weight which is actual plant food and the infinitesimal proportion this plant food bears to the total weight of arable soil, the use of 500 or more pounds per acre does not seem so large after all.

The large part of these formulas have been drawn by permission from the writing of Brooks, Van Slyke, Voorhees and

Woods, who have not stated them on the four acre, but the one acre, basis. In several cases it has been necessary in order to get even figures slightly to modify formulas—not enough so, however, seriously to affect their service. This results in some cases in the composition being incorrectly stated to the extent of a few tenths of one percent in some of the ingredients. It is felt, however, that the added convenience of the even hundred expression and usage will more than offset these minor errors.

Suitable soil or crop prescriptions, good under any and all circumstances, cannot be formulated with surety. A multitude of diverse conditions enter into the problem and make for confusion. Questions of soil variations, of seasonal influences, of past soil history and treatment, of the economic handling of home manurial resources, of varying uses for which a crop may be designed, are factors any one of which may so affect the situation as to render a given formula more or less inapplicable. Instances of this sort will readily occur to anyone at all conversant with the practice of fertilization. The farmer who has gained some knowledge of his soils through observation and experiment is in a position to improve very materially the formulas for his own farm and individual circumstances. They should be looked upon as suggestive rather than dictatorial, as hints rather than mandates.

Quantity is also an important matter, hardly second to that of quality. To prescribe the one and not the other were to leave half of the tale untold. And yet it is quite as impossible to lay down a final dictum for the one as for the other—and for much the same reasons. One may, however, use minima and maxima with some assurance.

It will be noted that quite different combinations are often proposed, yet these are far more in unison than are the offerings of the sundry fertilizer manufacturers. This is not to be wondered at, however, considering the differences which exist in the conditions in various sections of the country and to the fact, well recognized by agricultural investigators, that we "do not know it all" as yet, and that there is still much to be learned as to crop fertilization.

The crude stocks which are suggested are those in common use for this purpose and for the manufacture of mixed goods by the trade.

Some farmers in scanning these pages will query why the recommendations are not couched in terms of Smith's or Jones' or perhaps Brown's "phosphate" rather than as pounds of materials of which possibly they have never heard, and in pounds of plant food they do not comprehend. There are several very evident and thoroughly good reasons for this, among which may be mentioned:

1. The varying grade of the same brand one year to another.
2. The more or less unknown composition of manufactured goods.
3. The not infrequent changes in formulas of mixed goods one year with another.
4. The invidiousness of the practice.

It will not be difficult in some of the cases for anyone who does not care to take up the home mixing proposition to use mixed goods and with some degree of assurance that he is getting nearly the prescribed amounts of plant food. In the first place one should realize that for nine out of ten of the formulas no approach at matching them can be made with anything but the high grade goods. This throws four out of five of the mixed goods right out of consideration. One may then by using larger or smaller amounts than are called for, often, but by no manner of means always, match up the nitrogen and potash contents very well. It will usually be less easy to make good the phosphoric acid contents, as these are apt to run over high in the mixed goods. On every account, however, financial, educational, agricultural, it is better to buy the crude stock and home mix if one uses a ton or more.

The apparatus and process are simplicity itself. A tight barn floor, platform scales, a shovel with a square blade, an iron rake or hoe, and a sand screen, three mesh to the inch, comprise the outfit. Weigh, screen and pulverize all materials. Nitrate of soda in particular is apt to be lumpy. If emptied on the floor, very slightly moistened and allowed to stand over night, the lumps will fall apart on raking. It may be advisable to specify remilled nitrate in buying. The most bulky goods (usually the acid phosphate) are spread in an oblong pile from 6 to 12 inches deep. Upon its leveled top are placed one above another the other ingredients, the resulting pile resembling a layer cake. The pile is then mixed by careful shovelling, the shovel cutting down through all layers each time. The pile is then levelled again and the operation thrice repeated. The mixture may then be screened again if desired and stored in bulk, bags or barrels. If in good mechanical condition and in a dry place, the mixture may be kept for months before using without deterioration.

Meadows and Mowings

Fertilizers are used in connection with the hay crop at the time of seeding and also in subsequent years as a top dressing. In the one case the plant food is put into and in the other upon the soil. What will serve for the one will hardly suit the other. Then, again, the diverse methods and seasons of seeding down affect the practice of fertilization, as does also the character of the grasses or clovers used. Hence, several formulas have been suggested to meet these varying needs.

SEEDING DOWN

It is quite common to seed down after a well fertilized money crop or a highly manured corn crop, relying on the residual plant food for the initial support of the new stocking. This procedure is often a wise one. If it has not been followed, however, artificial fertilization should be employed. It should not be forgotten that heavy usage of nitrogen encourages the growth of grass rather than of clover, while liberal fertilization with phosphoric acid and potash tends to promote the clover crop.

FOR SUMMER AND FALL SEEDING

1. *For use without manure.*—This should be followed in the spring with a top dressing of 100 to 150 pounds per acre of nitrate of soda. Formula 1 carries but little nitrogen and that little is slow. It should be used only when the crop preceding the grass has been well fed with manure or highly nitrogenous fertilizer. If clover as well as grass is sown, use 800 to 1,200 pounds of muriate of potash instead of 200 to 300 pounds.

2. *For use without manure.*—On very poor soil 100 pounds per acre of nitrate of soda may be added. It should be followed in either case in the spring with a top dressing of 150 pounds per acre of nitrate of soda.

3. *For summer or fall seeding without manure.*

4. *For summer or fall seeding with manure.*

SUMMER OR FALL SEEDING DOWN

TO MIX FOR USE ON FOUR ACRES

Formula number	1*	2	3	3†	4	4†
Nitrate of soda	....	....	400	400	....	400
Raw ground bone ..	1200-1600	1200	....	....	....	....
7-15 tankage	....	800	1600	....	....	....
Acid phosphate	400-600	....	....	800	400	800
Wood ashes	1200-1600	....	....	....	....	....
Muriate of potash ...	200-300	800	400	600	300	600
Total for 4 acres.	3000-4100	2800	2400	1800	700	1800
Composition						
Nitrogen	1.4	3.3	6.3	3.6	—	3.6
Total phosphoric acid ..	11.4	14.0	10.0	6.7	8.6	6.7
Available phosphoric acid	5.0	5.4	5.0	6.2	8.0	6.2
Potash	5.3	14.0	8.3	16.6	21.7	16.6

---

*Acid phosphate and wood ashes are incompatibles, yet a modicum of the former, even though injured by the ashes, is thought by the writer to be a desirable addition to the formula, particularly if the fertilizer is sown promptly after mixing.

†For use the following spring.

5. *For spring seeding with oats and without manure.*

6. *For spring seeding with oats with plenty of manure.*

It should be noted that either formulas 1 or 2 cited above may be used for the purpose of spring seeding to advantage if the nitrate of soda top dressing of 100-150 pounds per acre, suggested in connection therewith, be commingled with the other ingredients instead of used separately. The nitrogen content would then be 27 to 38 pounds in No. 1 and 47 pounds in No. 2 and the analyses: Nitrogen 3.2 percent, total and available phosphoric acids 10 and 5 percents, potash 4.7 percent in No. 1, nitrogen 5.5 percent, total and available phosphoric acids 11.8 and 4.4 percents, potash 12.5 percent in No. 2.

7 and 8. *Very soluble and quickly available.*

9. *For market hay.*

10. (*First formula*) *for early spring application;* (*second formula*) *for application after harvest.*

11. *For mowing, clover being desired.*

No. 9 is designed more particularly for the growing of a market hay than for promoting clover growth, as is also the common application of 2-4 cords of manure. In fact formulas 7-10 are not calculated to that end, owing to their high nitrogen contents. Soil or seed inoculation, liming (lime or wood ashes) and less and slower nitrogen could help the clover more than would formulas 7-10. In the connection see formula 11: also formulas 13-15.

SPRING SEEDING (5, 6); SPRING TOP DRESSING (7-11)

TO MIX FOR USE ON FOUR ACRES

Formula number....	5	6	7	8	9	10	10*	11
Nitrate of soda	400	400	1400	400-800	600	600	400	....
Raw ground bone...	...	...	....	....	...	...	...	1600
7-15 tankage	2000	...	....	....	500	...	400	....
Acid phosphate	800	1600	1600	800-1600	200	400	400	800
Muriate of potash.....	600	1000	1000	300-600	200	200	200	600
Total for 4 acres..	3800	3000	4000	1500-3000	1500	1200	1400	3000
Composition								
Nitrogen	4.2	2.1	5.4	4.3	8.3	8.0	6.1	1.9
Total phos. acid......	10.5	8.0	6.0	8.2	7.2	5.0	8.3	16.0
Available phos. acid .	6.1	7.5	5.6	7.6	5.6	4.7	5.8	7.7
Potash	11.9	16.5	12.5	9.4	6.7	8.3	7.2	10.0

---

*For use after harvest.

Clovers and Alfalfa

Legumes in general, being nitrogen gatherers, need a less supply of artificial nitrogen than do the non-leguminous crops. The use of much nitrogenous fertilizer with these means money and plant food wasted, since the crop is not apt to be materially the better for it.

The successful growths of these valuable crops depends on many factors which cannot be referred to here. The soil should be in a high state of cultivation, should contain the nodule producing organisms—if it does not they should be placed therein—and may well be limed thoroughly the fall before seeding. Consult in this connection Vermont bulletins 94 on "Vermont Grasses and Clovers" and 114 on "Alfalfa in Vermont."

Oats and Rye

Oats are grown for grain or forage and for oat hay, and with peas for forage and for hay. Formula 38 may be used for either purpose for oat growing—formula 39 when grown with peas.

Formula 38 carries a high nitrogen percentage, but its total quantity is small and its form is such that it is apt to be used up before the danger period arrives, when lodging and rusting may be feared.

It is in general advised to use considerably more phosphoric acid and potash and some more available nitrogen for peas and oats than if oats alone are sown.

Van Slyke and Voorhees place oats and rye on a par as regards fertilization.

ORCHARD FRUITS

The fruits grown in Northern New England group into three classes: the tree fruits, the bush fruits and strawberries. It goes without saying that the apple and its habit of growth are so widely different from the strawberry and its habit of growth that the fertilization of the two needs must vary. Certain general principles obtain, however, which may be briefly outlined. Given a soil in good mechanical condition, of open texture, well drained, fairly well supplied naturally with plant food—if of limestone origin so much the better—and orcharding may be expected to succeed with less attention to fertilization than must needs be paid if success is sought on soil not thus constituted. Yet in any case, whether the soil is good, medium or poor, adequate fertilization may be expected to enhance the quality of the product as well as increase its quantity.

The practice of orcharding involves continuous cropping, growing the tree for years and then growing fruit and tree at the same time. The long life of a tree enables it to use relatively slow forms of plant food, but the great draft which large crops make calls for specific feeding at specific times to meet the large demand. During the growing period of trees nitrogen is particularly drawn upon; yet excess may force wood growth too late in the fall so that it does not "harden off," but winter kills. Later in the tree life soluble nitrogen tends to hinder fruit ripening.

Voorhees suggests for fruit trees in general two basic formulas: (69) equal parts by weight of ground bone, acid phosphate and muriate of potash; (70) one and a half parts of ground bone to one of muriate of potash.

On poor and light soils the feeding of the trees should begin at once; on those of better grade it may not begin when the orchard is set out. At the outset on poor soils considerable nitrogen is needed, which should be of the slow type. Tankage, the rather inert and hence cheaper forms of nitrogenous crude stock, or green manuring with legumes may be resorted to. If the latter practice is employed the crop should be turned under early lest it do more harm than good. Artificial feeding on good orchard soils may commence when the trees begin to bear.

Van Slyke suggests two formulas as alternatives, the amounts used increasing as the trees grow older.

Voorhees suggests that either Nos. 69 or 70, 400 pounds to an acre, may be used on good soils when trees begin to bear, these amounts increasing as the years go on; that on medium soils the fertilization should begin earlier, and on poor soils that formula 70 should be used and should be fortified. He further states that 1000-1500 pounds annually used with mature trees have been found to pay, enhancing quality, augmenting quantity and promoting longevity. Early spring applications, plowed in, are advised.

No. 13. *Clover and alfalfa; used without manure on soils carrying the proper root nodules.*

No. 14. *Clover and alfalfa used when crop is sown.*

No. 14a. *Clover and alfalfa. Subsequent annual top dressing (with manure).*

No. 38. *Oats and rye* (grain, hay, etc).

No. 39. *Peas and oats.*

No. 69. *For fruit trees in general* (see special statement above).

No. 70. *For fruit trees in general* (see special statement above).

No. 71. *Apples and pears.—Used in increasing amounts as trees grow older.*

No. 72. *Apples and pears.—Used in increasing amounts as trees grow older.*

TO MIX FOR USE ON FOUR ACRES

Formula number	13	14*	14(a)	38	39	69	70	71
Nitrate of soda	200	200	100-200	300-600	400-800	....	....	100-20
Dried blood	....	400 or	....	....	....	....	....	200-30
Cottonseed meal.....		600	....	....	....	....	....	......
Raw ground bone	....	....	....	....	......	400	600	......
Acid phosphate	1600	2000	800-1600	500-1000	800-1600	400	....	800-160
Muriate of potash	1000	1600	400-800	100-200	200-400	400	400	400-800
Total for 4 acres	2800	4200 or 4400	1300-2600	900-1800	1400-2800	1200	1000	1500-290
Composition								
Nitrogen	1.1	2.0	1.6	5.4	4.6	1.0	2	2.5
Total phos. acid	8.0	7.0	9.0	8.3	8.6	12.7	13.6	8.1
Avail. phos. acid	7.4	6.6	8.5	7.4	8.0	7.3	4.4	7.8
Potash	17.9	19.0	16.0	6.5	7.1	16.7	20.0	13.9

---

*Formula 14 used in the spring or when the crop is sown should be foll an annual surface application of a ton or two of half rotted stable manure, as of formula 14a.

†Or 2-4 tons wood ashes.

CORN

This crop is grown for green forage, for silage, for stooking, for husking (grain) and for the cannery or for green ears. According as its destiny varies its fertilization should be modified.

Voorhees suggests when corn is grown for *forage* the use on a well manured clover sod of 500 pounds of a 2—6—8 formula, and on a light, unmanured, stubble ground one carrying two and a half times as much nitrogen and a little more phosphoric acid and potash. He counsels the use of organic nitrogen, of acid phosphate to furnish the bulk of the available phosphoric acid, ground bone and tankage the remainder, and muriate or kainit for the potash. These conditions would be met by formulas 20 and 21.

Since nitrogen retards and phosphoric acid forces maturity, in formulating primarily for *ear corn* the well-informed husbandman in these northern latitudes of late spring and early fall frosts naturally uses nitrate nitrogen to start the crop and available phosphoric acid to ripen it. Formulas 26 and 30 seem better calculated than the others in the last paragraph for this purpose. Full better than either would seem to be either 32 or 33.

A green and succulent crop is sought for *canning* rather than one which is matured. Earliness is often a special object. Enough phosphoric acid to force the ear growth, and enough nitrate to start growth are indicated.

No. 19. *For green forage.*

No. 20. *For green forage; for clover sod well manured.*

No. 21. *For green forage; for light manured stubble.*

No. 22. *For silage or stooking (not to be husked).*

No. 23. *For silage or stooking (not to be husked); without manure.*

No. 24. *For silage or stooking (not to be husked); without manuring on clover sod; to be broadcasted and harrowed in.*

No. 25. *For silage or stooking (not to be husked); without manure on soil poor in humus; to be broadcasted and harrowed in.*

No. 26. *For silage or stooking (not to be husked); with manure on sod land.*

No. 27. *For silage or stooking (not to be husked); with manure on sod land.*

No. 28. *For silage or stooking (not to be husked); with manure on sod land.*

No. 29. *For silage or stooking (not to be husked); with moderate dressings of manure; to be broadcasted and harrowed in.*

No. 30. *For silage or stooking (not to be husked); with good dressing of manure.*

No. 31. *For silage or stooking (not to be husked).*

No. 32. *For husking; without manure.*

No. 33. *For husking; with good dressing of manure.*

No. 34. *For the cannery.*

TO MIX FOR USE ON FOUR ACRES

Formula number	19	20	21	22	23	24	25
Nitrate of soda	....	....	....	....	250	300-400	500-600
Dried blood	400-800	....	600	600	....	300-400	1200-1500
Cottonseed meal	600-1200	....	....	800	800	....	....
7-15 tankage	....	700	700	....	....	600-800	1200-1500
Acid phosphate	1000-2000	600	600	1400	1600	1000-1200	1000-1200
Muriate of potash	250-500	300	400	400	500	1000-1200*	1000-1200*
Dried loam	....	400	....	....	....	....	....
Total for 4 acres	2250-4500	2000	2300	3200	3150	3200-4000	4900-6000
Composition							
Nitrogen	4.1	2	4.6	3.8	3	3.8	5.7
Total phos. acid	6.9	9.6	8.4	6.6	7.6	7.5	6.8
Available phos. acid	6.3	6.8	6.0	6.1	7.1	5.8	4.8
Potash	6.4	8	8.8	9.4	8.0	15.0	10.0

---

*Sulphate of potash used instead of muriate.

TO MIX FOR USE ON FOUR ACRES

Formula number	27	28	29	30†	31	32	33
Nitrate of soda	400	400	500-600	100-200	....	100-200	100-100
Dried blood, high grade	....	....	....	....	1000 or	....	....
Cottonseed meal	....	800	....	400-600	1800	....	....
7-15 tankage	800	....	....	....	....	700-900	300-400
Raw ground bone	....	....	700-1000	....	....	....	....
Acid phosphate	1200	1600	700-1000	1200-2000	1200	1600-2000	1600-2100
Muriate of potash	600	600	500-600*	300-500	500	400-500	300-400
Total for 4 acres	3000	3400	2400-3200	2000-3300	2700-3500	2800-3600	2300-3000
Composition							
Nitrogen	3.6	3.5	4.2	2.2	3.7-4.8	2.1	1.6
Total phos. acid	10.3	7.1	11.3	9.0	5.2-6.8	12.3	11.2
Avail. phos. acid	7.6	6.6	6.3	8.4	4.8-6.3	9.9	10.8
Potash	10.0	8.8	10.0	7.6	7.0-9.0†	7.1	6.6

---

*Sulphate of potash used instead of muriate.

†If manure is scant this formula (30) may be fortified by an extra 25 poun nitrate of soda per acre, which will make its nitrogen content 3 percent instead c percent.

POTATOES

Potatoes are a standard New England crop. A large share of the mixed fertilizers of its trade bear that magic word, and it is the common notion that if a fertilizer is denominated a potato manure it needs must be among the best of its kind. As a matter of fact this reputation is but ill-deserved in many cases. To intimate that the many general purpose goods of a grade approximating 2—8—3, which are dubbed potato fertilizers, are especially adapted to that crop is to make a heavy draft on one's credulity. However, a large part of New England plant food purchases are made for this crop and considerable attention is due to the matter of its proper fertilization. Despite the low prices which sometimes obtain there is reason to believe that better conditions will prevail and that it will pay to give careful attention to the adequate fertilization of this money crop.

Potatoes thrive best on medium loams, the earlier crop favoring those which tend toward the sandy type, while the main crop does admirably on sod land. Thorough fitting of the seed bed is highly desirable. Speaking broadly, fertilizers do better by this crop than does manure. The crop is a larger user of nitrogen and of potash than of phosphoric acid.

There is a considerable market at good prices for early potatoes, though this is not a large item in Vermont potato growing. The fertilization of early potatoes should differ somewhat from that of the late crop, more and quicker plant food being furnished.

Voorhees states that on good potato soils not less than 800 pounds per acre of a goods carrying in quickly available forms 3-4 percent nitrogen, 6-8 percent phosphoric acid and 8-10 percent potash should be used, the latter to be as sulphate if quality and appearance are an object, and as muriate if they are not.

No. 61. *For late planting and short seasons.*[*]

No. 62. *For late varieties in a relatively longer season.*[†]

No. 63. *Aroostook formula.*[‡]

No. 64. *With manure, on sod land.*

No. 65. *To be scattered in a strip 6 inches to 1 foot wide instead of broadcasted; or half drilled and half broadcasted.*

---

[*] Contains more water soluble nitrogen and more available phosphate acid than No. 60.

[†] Contains less and slower nitrogen than No. 61.

[‡] Used by many Maine farmers 900-1300 per acre, and produced 275-380 bushels of late varieties. Formula tends to prolong growth; for a late planting and short season No. 61 is preferable.

Formulas 23 and 30 (corn), fortified perhaps with a little extra potash and—if the season bids fair to be short—with additional nitrate of soda, have proven excellent formulas for potato growth.

POTATOES

TO MIX FOR USE ON FOUR ACRES

Formula number	60	61	62	63	64	
Nitrate of soda	200-400	800	100-150	400	400	70
Sulphate of ammonia	200-400	....	....	....	....	.
Dried blood, high grade	....	400	....	....	....	90
Cottonseed meal	800-1600	....	600-800	800	....	.
7-15 tankage	....	800	....	2000	800	100
Acid phosphate	1600-3200	2000	1000-1300	1600	1200	140
Sulphate of potash	800-1600*	800	400-500	800	800	80
Filler	....	....	300-400	....	....	..
Total for 4 acres	3600-7200	4800	2400-3150	5600	3200	480
Composition						
Nitrogen	3.6	4.8	2.5	4.2	3.5	
Total phos. acid	6.7	8.8	6.3	9.6	9.4	
Available phos. acid	6.2	7.1	5.8	6.7	7.1	
Potash	11.1	8.3	8.3	7.1	12.5	

---

*Muriate or sulphate.

The following table may prove of service to such users of commercial p food as may wish to know how much of a given crude stock will furnis definite percentage composition in a half ton of fertilizer. Thus, for exan a farmer wishes to mix 1,000 pounds of fertilizer to test 3 percent nitroge percent phosphoric acid and 5 percent potash, the nitrogen to be one-third in form of nitrate of soda and two-thirds organic. He would use the table follows: Find the ingredient desired in the left hand perpendicular colu the percentage desired in the top horizontal column; the figure at the junc point gives the number of pounds to be used.

1% nitrogen (as nitrate) will be furnished by	65	pounds nitrate of soda
2% nitrogan (organic) will be furnished by	335	pounds tankage.
7% phosphoric acid will be furnished by	500	pounds acid phosphate
5% potash will be furnished by	100	pounds muriate of pot
	1,000	

AMOUNTS REQUIRED TO MAKE 1,000 POUNDS OF FERTILIZER

Percentage desired	1	2	3	4	5	6	7	8	9
15% nitrate of soda	65	130	195	260	325	...	...	...	...
Dried blood or 10% high grade tankage	100	200	300	400	500	...	...	...	...
Medium tankage or 6% cottonseed meal	170	335	500	665	830	...	...	...	...
14% acid phosphate	..	...	...	285	360	430	500	570	640
Muriate or 5% sulphate of potash....	20	40	60	80	100	120	140	160	180

59c

Vermont Agricultural Experiment Station

BURLINGTON, VT.

CIRCULAR NUMBER 8

April, 1911

PUBLICATIONS ON HAND

The Station has issued to date (April, 1911) 23 annual reports, 157 bulletins, 8 circulars and divers fugitive newspaper bulletins, some numbered and some unnumbered. Many of these are out of print. The following numbers are in print and will be sent on request so long as the supply may last.

BULLETINS

1887, June	No. 2,	Analyses of commercial fertilizers	2 pages
1888, April	No. 8,	Analyses of commercial fertilizers	8 pages
May.	No. 10,	New organization	8 pages
August.	No. 12,	Insecticides; seed tests; fertilizer analyses	16 pages
1889, March.	No. 14,	Analyses of commercial fertilizers	16 pages
October.	No. 17,	Test of cows at Vermont state fair	16 pages
1890, May.	No. 20,	Analyses of commercial fertilizers	16 pages
September.	No. 21,	A new milk test; testing milk at creameries and cheese factories	32 pages
1891, March.	No. 23,	Analyses of commercial fertilizers	16 pages
September.	No. 26,	Maple sugar	24 pages
1892, January.	No. 27,	Tests of dairy apparatus	12 pages
1893, May.	No. 35,	Analyses of commercial fertilizers	16 pages
1894, May.	No. 41,	Analyses of commercial fertilizers	16 pages
November.	No. 43,	Household pests	8 pages
1895, March.	No. 45,	Analyses of commercial fertilizers	8 pages
April.	No. 46,	Analyses of commercial fertilizers	24 pages
May.	No. 47,	Commercial fertilizers	36 pages
October.	No. 48,	Gluten feeds and meals	18 pages
1896, March.	No. 50,	Analyses of commercial fertilizers	8 pages
April.	No. 51,	Analyses of commercial fertilizers	12 pages
May.	No. 52,	Analyses of commercial fertilizers	24 pages
November.	No. 54,	Salad plants and plant salads	16 pages
1897, February.	No. 56,	Orange hawkweed or "paint brush"	16 pages
March.	No. 57,	Analyses of commercial fertilizers	16 pages
April.	No. 58,	Analyses of commercial fertilizers	16 pages
May.	No. 59,	Commercial fertilizers	32 pages
1898, March.	No. 63,	Analyses of commercial fertilizers	16 pages
April.	No. 64,	Analyses of commercial fertilizers	16 pages
December.	No. 67,	Hybrid plums	30 pages
1899, January.	No. 68,	Inspection of milk tests and feeding stuffs	8 pages

March.	No. 69,	Analyses of commercial fertilizers	16 pages
April.	No. 70,	Analyses of commercial fertilizers	16 pages
1900, March.	No. 76,	The forest caterpillar	28 pages
April.	No. 77,	Analyses of commercial fertilizers	24 pages
	No. 78,	Analyses of commercial feeding stuffs	24 pages
	No. 79,	Analyses of commercial fertilizers	12 pages
May.	No. 80,	Analyses of commercial fertilizers	48 pages
September.	No. 81,	Principles and practice of stock feeding (Revised edition in bulletin 152).	56 pages
1901, January.	No. 84,	Commercial feeding stuffs	16 pages
March.	No. 86,	Analyses of commercial fertilizers	24 pages
May.	No. 87,	Analyses of commercial fertilizers	48 pages
October.	No. 88,	Analyses of commercial feeding stuffs	16 pages
November.	No. 89,	Plum culture	12 pages
December.	No. 90,	Apple growing in Addison county	8 pages
1902, February.	No. 91,	Analyses of commercial feeding stuffs	16 pages
April.	No. 92,	Analyses of commercial fertilizers	24 pages
May.	No. 94.	Vermont grasses and clovers	40 pages
June.	No. 95,	A poisonous plant—the common horsetail	8 pages
September.	No. 96,	Apple pomace a good feed for cows	8 pages
September.	No. 97,	Analyses of commercial feeding stuffs	16 pages
1903, March.	No. 98,	Analyses of commercial fertilizers	24 pages
May.	No. 99,	Commercial fertilizers	88 pages
May.	No. 100,	Paying for separator cream at the creamery.	24 pages
September.	No. 101,	Commercial feeding stuffs	8 pages
October.	No. 102,	The measurement of saw logs	8 pages
December.	No. 103,	The maple sap flow	160 pages
1904, February.	No. 105,	The maple sap flow	32 pages
April.	No. 107,	Commercial fertilizers	24 pages
June.	No. 108,	Commercial fertilizers	68 pages
September.	No. 109,	Commercial feeding stuffs	8 pages
December.	No. 110,	Commercial feeding stuffs	12 pages
1905, April.	No. 112,	Commercial fertilizers	24 pages
April.	No. 114,	Alfalfa in Vermont	24 pages
May.	No. 115,	Disease-resistant potatoes	8 pages
October.	No. 117,	Commercial feeding stuffs	8 pages
December.	No. 118,	Commercial feeding stuffs	8 pages
1906, February.	No. 119,	Abstract of eighteenth report	48 pages
February.	No. 120,	Planting white pine in Vermont	16 pages
March.	No. 121,	Commercial fertilizers	24 pages
September.	No. 124,	Commercial feeding stuffs	8 pages
December.	No. 125,	Commercial feeding stuffs	8 pages
1907, March.	No. 126,	Commercial fertilizers	24 pages
April.	No. 127,	State nursery for forest tree seedlings	12 pages
April.	No. 128,	The testing of cows	36 pages
1908, January.	No. 132,	Forest planting in Vermont	16 pages
March.	No. 134,	Commercial fertilizers	24 pages
June.	No. 135,	Commercial fertilizers; a quarter century of fertilizer inspection; soil deterioriation and soil humus	128 pages

June.	No. 136,	Abstract 20th annual report (plant diseases, horticulture, weeds, insects)	40 pages
July.	No. 137,	Abstract 20th annual report (crops, forestry, stock feeding, dairy husbandry)	40 pages
1909, January.	No. 138,	Commercial feeding stuffs; the viability of weed seeds in feeding stuffs	20 pages
March.	No. 139,	Preliminary statement regarding forestry problems in Vermont	16 pages
March.	No. 140,	Commercial fertilizers	24 pages
April.	No. 141,	Apple culture in Vermont	40 pages
May.	No. 142,	Plant diseases, potato spraying	16 pages
August.	No. 144,	Feeding stuffs inspection; concerning commercial feeding stuffs	48 pages
October.	No. 145,	Vermont shrubs and woody vines	152 pages
November.	No. 146,	The grass and clover seed trade in Vermont in 1907-1909	40 pages
December.	No. 147,	The bacterial soft rots of certain vegetables	120 pages
1910, January.	No. 148,	A bacterial soft rot of muskmelon, caused by bacillus melonis, n. sp.	56 pages
January.	No. 149,	A practicable method of killing witch grass.	32 pages
March.	No. 150,	The role of anesthetics and other agents in plant forcing	32 pages
April.	No. 151,	Buddy sap	32 pages
April.	No. 152,	Commercial feeding stuffs; principles and practice of stock feeding	104 pages
May.	No. 153,	Plant diseases; potato spraying	16 pages
June.	No. 154,	Commercial fertilizers; soil classifications and adaptations	112 pages
September.	No. 155,	Principles and practice of ice cream making.	96 pages
1911, January.	No. 156,	The management of Vermont forests with especial reference to white pine	48 pages
March.	No. 157,	The damping off of coniferous seedlings....	32 pages

REPORTS

Ninth annual report (1895) ....240 pages
(Commercial fertilizers, feedings stuffs, pig feeding, potato diseases, bordeaux mixture, orchard diseases, oat smut, onion mildew, orange hawkweed, insects, beekeeping, least squares as a method of determining feed values, variations in milk, herd records, fast and slow milking, dairy feeding).

Thirteenth annual report (1899-1900) ....256 pages
(Potato diseases, leaf scorching, killing weeds with chemicals, impurities in grass and clover seed, a bacterial soft rot of vegetables, plum propagation and pollination, apple pollination, plums, composition of potatoes and artichokes, dairy feeding, food effects on butter quality, herd records).

Fourteenth annual report (1900-1901) ....240 pages
(Nitrogen free extract matter of potatoes and artichokes, organic nitrogen availability in fertilizers, testing Babcock apparatus, potato diseases, disease of greening apples, fowl meadow grass, killing weeds with chemicals, bird vetch, two new weeds, plum propagation, hybrid plums, Grand Isle apple inventory, dairy feeding, comparison of feeding trial methods, effect of feed on the quality of butter).

Fifteenth annual report (1901-1902) ....196 pages
(Potato diseases, orchard diseases, locust tree cultivation, killing weeds in lawns, plum propagation, hybrid plums, dairy feeding, comparison of feeding trial methods, herd records, score card judgment vs. performance records, effect of feed on quality of butter, the change from barn to pasture).

Sixteenth annual report (1902-1903) ....190 pages
(Plant diseases, potato maladies and their prevention, weeds, the shrubby cinquefoil, apple tree borers, mushrooms, fertilizer analyses, dairy husbandry, including feeding trials, herd records, etc.).

Seventeenth annual report (1903-1904) ....228 pages
(Plant diseases, seed inspection, tomato growing, lettuce growing, bridge grafting, bordeaux mixture preparation, rhubarb forcing, maple sugar and syrup adulteration, dairy feeding, herd records).

Eighteenth annual report (1904-1905) ....224 pages
(Plant diseases, lettuce culture, soil sterilization, winter injury to apple trees, influence of stock on scion, miscellaneous fruit notes, adulteration of maple sugar and syrup, influence of changes in feed upon milk production, dairy feeding, methods of milking, comparison of udder conformation and milk production, herd records).

Nineteenth annual report (1905-1906) ....192 pages
(Plant diseases, alfalfa culture, anesthetics in forcing plants, oyster-shell and San Jose scales, the creamery inspection law, feeding trials with cows, the effect of frost on corn for silage, alfalfa meal, the effect of freezing milk on the quality of butter. the effect of age on the yield and quality of milk).

Twentieth annual report (1906-1907) ....224 pages
(Potato diseases, tree seedling diseases, nursery for tree seedlings, carnation crossing, muskmelon industry, squash storage, drug plant cultivation, a resumé of 20 years work in plant pathology, weeds, insects, horticulture, crops, forestry, maple investigation, fertilizers, feeds, chemistry, stock feeding, dairy husbandry).

Twenty-first annual report (1907-1908) ....296 pages
Contains 32 pages of business matter and bulletins 131-137 inclusive.

Twenty-second annual report (1908-1909) ....280 pages
Contains 20 pages of business matter and bulletins 138-143 inclusive, and circulars 1-3 inclusive.

Twenty-third annual report (1909-1910) ....776 pages
Contains 24 pages of business matter and bulletins 144-154 inclusive, and circulars 4 and 5.

CIRCULARS

1909, March.	No. 1,	The bulletins of the fertilizer control	4 pages
June.	No. 3,	Concerning the work which the Station can and cannot undertake for residents of the state	8 pages
1910, January.	No. 4,	Forest nursery stock for distribution in spring of 1910	4 pages
January.	No. 5,	Concerning bulletins 145, 147, 148 and 150	2 pages
1911, January.	No. 6,	Forest nursery stock for distribution in spring of 1911	8 pages
March.	No. 7,	Plant food combinations for sundry crops	16 pages
April.	No. 8,	Publications on hand	8 pages

The following reports and bulletins listed by subjects are available for distribution. Others of ephemeral value (e. g. the earlier fertilizer bulletins) are also in print but are not listed herewith. Others in the lapse of time and because of changes in methods, etc., have become obsolete. Such publications have value today only for the filling of library files. The publications listed herewith, however, are thought to be as valuable today as ever, and are at the service of anyone who may desire them. It is suggested that parties desiring them ask not for specific numbers but for publications dealing with the desired subject.

Alfalfa growing.—Bulletins 114, 137; 19th report (a discussion of alfalfa success and failure in Vermont).

Dairy husbandry and stock feeding.—Bulletins 17, 21, 48, 68, 95, 96, 100, 119, 128, 137, 138, 144, 152, 155; 9th, 13th to 22nd reports, inclusive, (covering a wide range of matter, but mostly having to do with the feeding of or foods for dairy cattle).

Feeds.—Bulletins 48, 68, 95, 96, 137, 138, 144, 152; 9th, 13th, 14th, 15th, 20th, 21st reports.

Fertilizers.—Bulletins 99, 108, 135, 154; 22nd report.

Forestry.—Bulletins 102, 120, 127, 132, 137, 139, 156; 15th report. (The forest problems and policy of the State; State nursery distribution of seedlings).

Fruit growing.—Bulletins 67, 89, 90, 119, 136, 141; 9th, 13th to 23rd reports. (Plums, apples, spraying, etc.).

Grasses.—Bulletin 94; 14th report.

Insects.—Bulletins 12, 43, 76, 119, 136, 141; 9th, 16th, 19th, 20th reports. (Household pests, tent caterpillars, appletree borers, etc.).

Maple products.—Bulletins 26, 103, 105, 119, 151; 17th, 18th, 20th reports.

(Sugar making for the bounty, the chemistry, physiology and bacteriology of the sap flow, maple sugar adulterations, cause of inferior products).

Plant diseases.—Bulletins 119, 136, 142, 147, 148, 153, 157; 9th, 13th to 23rd reports. (Mostly discussions of potato maladies).

Potato growing.—Bulletins 115, 119, 136, 142, 153; 9th, 13th to 23rd reports.

Shrubs, etc.—Bulletin 145.

Soils.—Bulletins 135, 154; 18th and 22nd reports.

Spraying.—Bulletins 119, 136, 142, 153; 9th, 13th, to 23rd reports.

Vegetables.—Bulletins 54, 150; 17th and 18th reports.

Weeds.—Bulletins 56, 138, 146, 149; 9th, 13th, 17th, 20th reports. (Paint-brush, shrubby cinquefoil, seed inspection, weed seeds in feeds).

Vermont Agricultural Experiment Station

BURLINGTON, VT.

CIRCULAR NUMBER 9

April, 1915

PUBLICATIONS FOR FREE DISTRIBUTION

The Station has issued to date (April, 1915) 27 annual reports, 188 bulletins, 9 circulars and divers fugitive newspaper bulletins, some numbered and some unnumbered. Many of these are out of print. Several which are in print have now no value whatsoever, save for filling library files; for example, Nos. 23, 51, 58, 77, 79, 86, 107, 112, 121, 126, 134, 140. The following numbers are in print and will be sent on request without charge so long as the supply lasts.

1890, September	No. 21,	A new milk test; testing milk at creameries and cheese factories	32 pages
October	No. 22,	Tests of dairy cows; home vs. fair grounds	12 pages
1891, March	No. 23.	Analysis of commercial fertilizers licensed for sale in the State of Vermont in the year 1891	16 pages
September	No. 26,	Maple sugar	24 pages
1896, April	No. 51,	Analyses of commercial fertilizers	12 pages
1897, April	No. 58,	Analyses of commercial fertilizers	16 pages
1898, December	~~No. 67,~~	Hybrid plums	30 pages
1890, January	No. 68,	Inspection of milk tests and feeding stuffs	8 pages
1900, March	No. 76,	The forest caterpillar	28 pages
March	No. 77,	Analyses of commercial fertilizers	24 pages
April	No. 78,	Analyses of commercial feeding stuffs	24 pages
April	No. 79,	Analyses of commercial fertilizers	12 pages
1901, March	No. 86,	Analyses of commercial fertilizers	24 pages
May	No. 87,	Analyses of commercial fertilizers	48 pages
1902, May	No. 94,	Vermont grasses and clovers	40 pages
1904, April	No. 107,	Commercial fertilizers	24 pages
September	No. 109,	Commercial feeding stuffs	8 pages
December	No. 110,	Commercial feeding stuffs	12 pages
1905, April	No. 112,	Commercial fertilizers	24 pages
May	No. 113,	Spraying; spray calendar	8 pages
October	No. 117,	Commercial feeding stuffs	8 pages
December	No. 118,	Commercial feeding stuffs	8 pages
1906, February	No. 119,	Abstract of eighteenth report	48 pages
February	No. 120,	Planting white pine in Vermont	16 pages
March	No. 121,	Commercial fertilizers	24 pages
September	No. 124,	Commercial feeding stuffs	8 pages
December	No. 125,	Commercial feeding stuffs	8 pages

1907, March	No. 126,	Commercial fertilizers	24 pages
September	No. 131,	Commercial feeding stuffs	8 pages
1908, March	No. 134,	Commercial fertilizers	24 pages
June	No. 136,	Abstract 20th report (plant disease, horticulture, weeds, insects)	40 pages
July	~~No. 137~~,	Abstract 20th report (crops, forestry, stock feeding, dairy husbandry)	40 pages
1909, January	~~No. 138~~,	Commercial feeding stuffs; the viability of weed seeds in feeding stuffs	20 pages
March	~~No. 139~~,	Preliminary statement regarding forestry problems in Vermont	16 pages
March	No. 140,	Commercial fertilizers	24 pages
April	~~No. 141~~,	Apple culture in Vermont	40 pages
May	No. 142,	Plant diseases, potato spraying	16 pages
June	~~No. 143~~,	Commercial fertilizers; soil physiography	144 pages
August	No. 144,	Feeding stuffs inspection; concerning commercial feeding stuffs	48 pages
October	No. 145,	Vermont shrubs and woody vines	152 pages
November	No. 146,	The grass and clover seed trade in Vermont in 1907-1909	40 pages
December	~~No. 147~~,	The bacterial soft rots of certain vegetables	120 pages
1910, January	No. 148,	A bacterial soft rot of muskmelon, caused by Bacillus melonis n. sp.	56 pages
January	~~No. 149~~,	A practicable method of killing witch grass	32 pages
March	No. 150,	The role of anesthetics and other agents in plant forcing	32 pages
April	No. 151,	Buddy sap	32 pages
April	No. 152,	Commercial feeding stuffs; principles and practice of stock feeding	104 pages
May	No. 153,	Plant diseases; potato spraying	16 pages
June	No. 154,	Commercial fertilizers; soil classifications and adaptations	112 pages
September	No. 155,	Principles and practice of ice cream making	96 pages
1911, January	No. 156,	The management of Vermont forests with especial reference to white pine	48 pages
March	No. 157,	The damping off of coniferous seedlings	32 pages
May	No. 158,	Commercial feeding stuffs; concerning summer soiling suggestions	40 pages
May	No. 159,	Plant diseases; twenty years' spraying for potato diseases; potato diseases and the weather	82 pages
June	No. 160,	Commercial fertilizers; limes and liming	42 pages
1912, January	~~No. 161~~,	Hemlock in Vermont; comparative study of log rules	32 pages
January	No. 162,	Plant diseases in 1911; potato spraying experiments in 1911	12 pages
February	No. 163	Mendelian inheritance in the carnation.	22 pages
March	~~No. 164~~,	Commercial feeding stuffs; condimental feeds	60 pages
June	No. 165,	Peat and muck deposits of Vermont	102 pages
June	No. 166,	Commercial fertilizers	76 pages
June	No. 167,	Micro-organisms of maple sap	284 pages

August	~~No. 168~~,	Investigations of the potato fungus Phytophthora infestans	108 pages
October	No. 169,	Cultural studies of the Montreal market muskmelon	12 pages
December	No. 170,	"Mony meikles mak a muckle"	18 pages
1913, April	No. 171,	Commercial feeding stuffs; concerning the Vermont hay crop	56 pages
May	No. 172,	Place-effect influence on seed potatoes	18 pages
June	~~No. 173~~,	Commercial fertilizers; the principles of land drainage	94 pages
June	~~No. 174~~,	Methylene blue, a remedy for infectious abortion	10 pages
October	~~No. 175~~,	Studies of club-root. 1. The relation of Plasmodiophora brassicae to its host and the structure and growth of its plasmodium	28 pages
1914, January	No. 176,	The management of second growth hardwoods in Vermont	58 pages
February	No. 177,	Large seed a factor in plant production	36 pages
March	No. 178,	Studies in tolerance of New England forest trees. I. Development of white pine seedling in nursery beds	18 pages
April	No. 179,	Disease resistance of potatoes	38 pages
May	No. 180,	Commercial feeding stuffs; concerning feeding practice	46 pages
May	No. 181,	Studies in tolerance of New England forest trees. II. Relation of shade to evaporation and transpiration in nursery beds	30 pages
June	No. 182,	Commercial fertilizers; irrigation	102 pages
June	No. 183	Agricultural seeds	26 pages
September	No. 184,	Potato scab	64 pages
November	No. 185,	Studies of club-root. II. Disease resistance of crucifers; methods of combating club-root	30 pages
1915, February	No. 186,	Farm storage of apples	40 pages
March	No. 187,	The flora of Vermont	100 pages
April	No. 188,	Forest planting in Vermont as an investment	40 pages

REPORTS

1904-05 ~~Eighteenth~~ 224 pages (plant diseases, lettuce culture, soil sterilization, winter injury to apple trees, influence of stock on scion, miscellaneous fruit notes, adulteration of maple products, influence of changes of feed upon milk production, dairy feeding, methods of milking, comparisons of udder conformation and milk production, herd records).

1908-09 Twenty-second, 20 pages and bulletins 138-143.

1909-10 Twenty-third, 24 pages and bulletins 144-154.

1911-12 Twenty-fifth, 24 pages and bulletins 161-168.

1912-13 Twenty-sixth, 20 pages and bulletins 169-174.

1913-14 Twenty-seventh, 20 pages and bulletins 175-183.

CIRCULARS

1909, March	No. 1,	The bulletins of the fertilizer control	4 pages
June	No. 3,	Concerning the work which the Station can and cannot undertake for residents of the State	8 pages
1910, January	No. 4,	Forest nursery stock for distribution in spring of 1910	4 pages
January	No. 5,	Concerning bulletins 145, 147, 148 and 150.	2 pages
1911, January	No. 6,	Forest nursery stock for distribution in spring of 1911	8 pages
March	No. 7,	Plant food combinations for sundry crops.	16 pages
April	No. 8,	Publications on hand	8 pages
1915, April	No. 9,	Publications for free distribution	8 pages

The following reports and bulletins listed by subjects are available for distribution. Some of ephemeral value (e. g. the earlier fertilizer bulletins) are not thus listed. Others, in the lapse of time and because of changes in methods, etc. have become obsolete. Such publications have value today only for the filling of library files. The publications listed herewith, however, are thought to be as valuable today as ever and are at the service of anyone who may desire them. It is suggested that parties desiring them ask not for specific numbers but for publications dealing with the desired subject.

Dairy husbandry and stock feeding.—Bulletins 21, 22, 119, 137, 144, 152, 155, 158, 164, 170, 171, 174, 180; 18th report.

Feeds.—Bulletins 137, 138, 144, 152, 158, 164, 170, 171, 180.

Fertilizers.—Bulletins 143, 154, 160, 165, 166, 173, 182; Circular 7.

Forestry.—Bulletins 120, 137, 139, 156, 157, 161, 176, 178, 181, 188.

Fruit growing.—Bulletins 67, 119, 136, 141, 148, 169, 186, 18th report.

Grasses.—Bulletins 94, 146, 149, 171, 183.

Insects.—Bulletins 76, 119, 136.

Maple products.—Bulletins 26, 119, 151, 167; 18th report.

Plant diseases.—Bulletins 119, 136, 142, 147, 148, 153, 157, 159, 162, 168, 175, 184, 185; 18th report.

Potato growing.—Bulletins 119, 136, 142, 153, 159, 162, 168, 172, 179.

Seeds.—Bulletins 146, 710, 183.

Shrubs, etc.—Bulletins 145, 187.

Soils.—Bulletins 143, 154, 160, 165, 173, 182; 18th report.

Spraying.—Bulletins 113, 119, 136, 142, 153, 159, 162, 168; 16th, 18th and 19th reports.

Vegetables, flowers, etc.—Bulletins 150, 163, 170, 177.

Weeds.—Bulletins 136, 138, 146, 149, 170, 183.

V59c

DEPARTMENT
OF FORESTRY

VERMONT AGRICULTURAL EXPERIMENT STATION, BURLINGTON, VT.

CIRCULAR NO. 9 (1924-25 EDITION)

COMPLETE LIST OF ALL AVAILABLE PUBLICATIONS, ARRANGED CHRONOLOGICALLY.

NOTE. A great many of these bulletins are now absolutely useless except to fill files. These are marked with a *. Do not ask for them for any purpose other than to fill files.

Some of these bulletins listed below are nearly useless, being out of date.

The bulletins and reports were issued about as follows:

1886-1899.	Bulletins 1- 83.	Reports I-XIII.
1900-1904.	Bulletins 84-110.	Reports XIV-XVIII.
1905-1909.	Bulletins 111-147.	Reports XIX-XXIII.
1910-1914.	Bulletins 148-185.	Reports XXIV-XXVIII.
1915-1919.	Bulletins 186-215.	Reports XXIX-XXXI.
1920-1924.	Bulletins 216-243.	

Any publication listed below will be sent without charge to any address on application. A postal card to the Experiment Station, Burlington, Vt., stating desires, is sufficient. In case several numbers are desired it is suggested that they be checked on this list and sent to the Station.

21* A New Milk Test; Testing Milk at Creameries and Cheese Factories.
23* Commercial Fertilizers.
41* Commercial Fertilizers.
77* Commercial Fertilizers.
78* Commercial Fertilizers.
86* Commercial Fertilizers.
87* Commercial Fertilizers.
88* Commercial Feeding Stuffs.
91* Commercial Feeding Stuffs.
92* Commercial Fertilizers.
94 Vermont Grasses and Clovers.
97* Commercial Feeding Stuffs.
98* Commercial Fertilizers.
102 The Measurement of Saw Logs.
107* Commercial Fertilizers.
109* Commercial Feeding Stuffs.
110* Commercial Feeding Stuffs.
112* Commercial Fertilizers.
117* Commercial Feeding Stuffs.
118* Commercial Feeding Stuffs.
121* Commercial Fertilizers.
123 Commercial Fertilizers; The Moisture Relations of the Soil.
124* Commercial Feeding Stuffs.
125* Commercial Feeding Stuffs.
126* Commercial Fertilizers.
131* Commercial Feeding Stuffs.

134* Commercial Fertilizers.
138 Commercial Fertilizers; The Viability of Weed Seeds in Feeding Stuffs.
139 Forestry Problems for Farmers.
140* Commercial Fertilizers.
141 Apple Culture in Vermont.
142 Plant Diseases; Potato Spraying.
143 Commercial Fertilizers; Soil Physiography.
144 Commercial Feedings Stuffs; Concerning Commercial Feeding Stuffs.
145 Vermont Shrubs and Woody Vines.
146 The Grass and Clover Seed Trade of Vermont.
147 The Bacterial Soft Rots of Certain Vegetables.
148 A Bacterial Soft Rot of Muskmelon.
149 A Practicable Method of Killing Witch Grass.
150 The Rôle of Anesthetics and Other Agents in Plant Forcing.
151 "Buddy Sap."
152 Commercial Feeding Stuffs; Principles and Practice of Stock Feeding.
153 Plant Diseases; Potato Spraying.
154 Commercial Fertilizers; Soil Classifications and Adaptations.
156 The Management of Vermont Forests with Special Reference to White Pine.
157 The Damping Off of Coniferous Seedlings.
158 Commercial Feeding Stuffs; Concerning Feeding Standards; Summer Soiling Suggestions.
159 Plant Diseases; Twenty Years Spraying for Potato Diseases; Potato Diseases and the Weather.
162 Plant Diseases; Potato Spraying Experiments.
163 Mendalian Inheritance in the Carnation.
166* Commercial Fertilizers.
167 Micro-organisms of Maple Sap.
168 Investigations of the Potato Fungus *Phytophthora Infestans.*
169 Cultural Studies of the Montreal Market Muskmelon.
170 "Mony Meikles Mak a Muckle" I. (articles on dairy husbandry, weeds, seeds).
171 Commercial Feeding Stuffs; Concerning the Vermont Hay Crop.
172 Place-Effect Influence on Seed Potatoes.
173 Commercial Fertilizers; The Principles of Land Drainage.
174 Methylene Blue; Infectious Abortion.
175 Studies on Club Root.
176 The Management of Second Growth Hardwoods in Vermont.
177 Large Seed a Factor in Plant Production.
178 Tolerance of New England Forest Trees; I. Development of White Pine Seedlings in Nursery Beds.
179 Disease Resistance of Potatoes.
180 Commercial Feeding Stuffs; Concerning Feeding Practice.
181 Tolerance of New England Forest Trees; II. Relation of Shade to Evaporation and Transpiration in Nursery Beds.
182 Commercial Fertilizers; Concerning Irrigation.
183* Agricultural Seed.
184 Potato Scab.
185 Studies of Club Root; Disease Resistance of Crucifers; Methods of Combating Club Root.
186 Farm Apple Storage.
187 Flora of Vermont; List of Ferns and Seed Plants Growing Without Cultivation.
188 Forest Planting in Vermont As An Investment.
189 Commercial Feeding Stuffs; Concerning the Corn Crop.
190 Commercial Fertilizers; Concerning Crop Rotation.
191 The Red Rot of Conifers.
192* Agricultural Seed.
193 Tolerance of New England Forest Trees III; Discontinous Light in Forests.
194 The Trees of Vermont.

195 The Values of Different Milk Grades in Infant Feeding.
196 Some Studies on Bordeaux Mixture.
197 Commercial Feeding Stuffs; Concerning the Oat Crop.
198 Commercial Fertilizers; Concerning Tillage.
199* Twenty-ninth Annual Report.
200 Agricultural Seed; Concerning Weeds and Weed Seeds.
201 Value of Different Grades of Milk in Infant Feeding.
202 "Mony Meikles Mak a Muckle" II. (articles on dairy husbandry).
203 "Mony Meikles Mak a Muckle" III. (articles on horticulture and maple products).
204 Commercial Feeding Stuffs; Concerning Alfalfa and Soy Beans.
205 Agricultural Seed; Concerning the Germination of Seed.
206 Commercial Fertilizers; Concerning Farm Manures.
207 The Manufacture of Commercial Fertilizers.
208 The Cost of Producing Market Milk in 1916-17 on 212 Vermont Farms.
209* Thirtieth Annual Report.
210 The Frustrum Form Factors of Hard Maples and Yellow Birch.
211 The Aerial Fertilization of Plants with Carbon Dioxid.
212* Thirty-first Annual Report.
213 Cold Storage of Cottage and Other Soft Curd Cheeses.
214 Tip Burn of the Potato and Other Plants.
215 Resistance of Potato Tubers to Scab.
216* Commercial Fertilizers, Commercial Feeding Stuffs, Agricultural Seed.
217 Blackberries of New England—Their Classification.
218 Blackberries of New England—Genetic Status of the Plants.
219 Eccentric Growth and the Formation of Red Wood in the Main Stem of Conifers.
220* Commercial Fertilizers, Commercial Feeding Stuffs, Agricultural Seed.
221 First Fifteen Years of a 40-Variety Apple Orchard; Apple Cion Selection from High- and Low-yielding Parent Trees.
222 Yield and Quality in Hubbard Squash.
223* Commercial Fertilizers, Commercial Feeding Stuffs, Agricultural Seed.
224 Violets of North America.
225 The Protein Requirements of Dairy Cows.
226 The Maintenance Requirements of Dairy Cattle.
227 Marketing Vermont Maple-Sap Products.
228* Commercial Fertilizers, Commercial Feeding Stuffs, Agricultural Seed.
229 The Protein and the Maintenance Requirements of Dairy Cattle.
230 Concerning Blood Complement.
231 Concerning Infectious Abortion.
232 Sterility of Strawberries; Strawberry Breeding.
233* Agricultural Seed.
234* Commercial Fertilizers.
235 Tolerance of New England Forest Trees; IV. Minimum Light Requirement Referred to a Definite Standard.
236 Commercial Feeding Stuffs.
237 Commercial Feeding Stuffs.
238 The Effects of Air Temperature and Relative Humidity on the Transpiration of Pinus Strobus.
239 Some Natural Violet Hybrids of North America.
240 Commercial Fertilizers.
241 Agricultural Seed.
242 Commercial Feeding Stuffs.
243 ————————.

Reports XXI to XXXI, inclusive (1907-1917).
Reports XXII to XXX, inclusive contain the bulletins for the current year.

Vermont Agricultural Experiment Station
Burlington, Vt.

CIRCULAR NUMBER 10

December, 1915

CONCERNING THE USE OF COMMERCIAL FERTILIZERS IN 1916

The present situation in the commercial fertilizer trade is utterly unlike anything hitherto experienced. The line of reasoning on which manufacturers heretofore have proceeded in the formulation of their mixtures and the experiment station and extension service people have proceeded in proffering suggestions to farmers as to the use of plant food, no longer in all respects is valid. It has seemed desirable, therefore, to set forth the causes which have brought about this situation and succinctly to indicate desirable procedures for the coming year. The directors of the Experiment Stations of the North Atlantic States (other than Pennsylvania) met on November 29 to review the situation. This circular is born of their meeting and in a general way represents their united judgment as to the wisest procedure in view of the untoward circumstances now confronting New England farmers; not that its suggestions will be applicable universally—for there are many sorts of soils and many kinds of farming—but perhaps in some degree they may be helpful in a trying situation.

I. 1916 Trade Abnormalities

1. The commercial potash supply practically is exhausted and none is in sight. A few manufacturers of commercial fertilizers will sell not to exceed one percent in some of their brands. Pacific kelps, certain western mineral deposits and various processes now in an experimental stage, may afford relief at some future time, but so far as 1916 crops are concerned, potash is a negligible quantity. Muriate is quoted at $530 a ton, thirteen times its normal price.

2. Upwards of a half million tons of sulphuric acid, ordinarily used in making acid phosphate, have been diverted to the manufacture of munitions. Naturally this has affected the market prices of acid phosphate and of mixed goods. It is only just to the fertilizer trade in this section of the country to say that, in many instances at any rate, it has refused to sell its acid, not on account of altruistic motives but because it looks beyond 1916 and immediate profits to the holding of its business in succeeding years.

3. The European export business in phosphate rock has ceased, many Florida phosphate mines have closed or work only part-time, and a curtailed supply is being secured at a higher cost.

4. Coastwise freights have increased greatly in cost, owing to war conditions.

5. In part, at least, on these accounts, acid phosphate has gone up in cost within the past few weeks like an ascending rocket and it does not seem as yet to have reached the heights. It has jumped nearly a dollar in price during the past two weeks and is now quoted at practically twice the sum at which it was offered in early September. It now wholesales at so high a price—it is quoted at $14—as to be at the extreme limit of its agricultural value. Farmers well may hesitate to pay present prices for acid phosphate whether offered in mixed goods or crude stock; yet there is no adequate substitute for it.

6. Nitrate of soda is relatively scarce and quoted at high figures: $65 a ton in mid-December as compared with $49 in mid-August. It is used largely by the munitions trade, and, being mined only in Chili, present deliveries are delayed by the blocking of the Panama Canal and the long detour around Cape Horn. It is now, so far as farmers are concerned, to be looked upon as a luxury.

7. Sympathetically, other forms of plant food seem to have moved upwards in their wholesale quotations. Thus, for example, cottonseed meal, which is largely used in fertilizer manufacture in the South and very freely in Connecticut in the tobacco regions, sold f.o.b. southern shipping points in mid-August at $23, but from November 1 to mid-December it has ranged from $31 to $33.50 at southern points. Wholesale seaboard quotations on sulphate of ammonia have increased in the same time from $71 to $80; since November 1 about $4 a ton more has been asked for tankage than was asked in August; dried blood has jumped from $32 to $41 and fish scrap from $31 to $43. Bone and raw phosphate rock have not changed, and cyanamid thus far has increased but about 10 percent on its late summer prices. Refined potash salts have more than doubled in price since August, selling now at approximately $500 a ton, although kainit is still quoted at $40 flat.

II. Fundamental Considerations

What should farmers do, now that potash is lacking and fertilizers are costly? Recourse should be had to the fundamentals.

1. Adequate tillage operations should be carried on, since they tend to set free plant food and to maintain a satisfactory soil water

supply as well as in other ways to increase the likelihood of satisfactory crop growth. (In this connection, see the article on "The Philosophy of Tillage," in the first report of the State Commissioner of Agriculture for 1909, pages 114-119; free for the asking of Hon. E. S. Brigham, Commissioner of Agriculture, St. Albans, Vt.).

2. Home manurial resources should be carefully conserved. Special effort should be exerted to prevent all liquid manure wastes, since nearly all the potash in the food as well as the more soluble nitrogen is excreted in the urine. More and better absorbents should be used and stable floors should be made water-tight. Leaves, waste stalks, trash of many sorts are worth saving and may be worked over by pigs. The earth beneath leaky stables or pens or in open yards or pens where cattle have been confined, may be scraped off and used to advantage, since it is apt to contain a good deal of potash as well as other forms of plant food. Peat beds and muck swamps may be turned to advantage, the material being used on the land directly, used, with care, as absorbents, or composted with barnyard manures, etc. Samples of peat or muck which are taken in accordance with methods furnished on request by the Vermont Station will be analyzed without charge. (In this connection see Vermont Bulletin 165 on "the Peat and Muck Deposits of Vermont"; free for the asking of the Station; also Farmers' Bulletin 192 on "Barnyard Manures," free for the asking of your Congressman or of the United States Department of Agriculture, Washington, D. C.).

3. It may be well to apply farm manures more promptly than usual and, also, to spread them more thinly. There is some reason to believe that lighter dressings used over larger areas would be a better procedure than that commonly employed.

There is a wide variation in manures, owing to differences between species of animal, feeds, care, beddings, and to other causes. Speaking in general terms, however, a ton of average manure carries about 10 pounds of nitrogen, 10 pounds of potash and 7 pounds of phosphoric acid and a cord carries from two and a half to three times as much, though a cord of horse manure may contain but two tons. The urine contains practically all the potash, as already has been remarked. Manure may be used this year on crops which ordinarily are grown solely on commercial fertilizers.

If for any reason manure is stored, more than usual care should be taken to compact the pile, to make its sides nearly vertical and to seek to lessen moisture losses.

4. Wood ashes, lime-kiln ashes, brick-kiln ashes and the like, should be saved carefully; but they *should not* be mixed with hen manure or commercial fertilizer containing acid phosphate.

5. Liming often will prove worth while. Most Vermont soils are acid and respond well to lime. Lime in the form of limestone, marl, quick or slaked limes does not seem to make soil potash available; but lime in the form of gypsum or land plaster is thought to some extent to accomplish that end. (In this connection see Vermont Station Bulletin 160 on "Limes and Liming"; free for the asking).

It should be said further, since in 1916 farmers will need to scan their fertilizer purchases with unusual care and, perhaps, to curtail them, that they may turn their energies with propriety for the time being to other means of soil improvement, to underdrainage, to irrigation, and to crop rotation. Such as may be thus minded are referred to Vermont Station bulletins 173 (drainage), 182 (irrigation), and 190 (crop rotation), any or all of which are free for the asking. Indeed it is not too much to say that a healthy soil is to be preferred to great riches; that adequate humus and lime contents, a non-acid condition, ample but not excessive water supplies, and good tilth, are necessary precedents to successful fertilization in any year, and especially in 1916.

III. Concerning Sources of Plant Food

Nitrogenous. Both mineral and organic forms should be used for general crops.

Nitrate of soda of course ranks higher in availability than any other nitrogen-bearing crude stock. In this northern land where many crops must mature in a relatively short season, the quickest nitrogen is none too rapid promptly to start a crop. Hence it is that the writer long has held that under normal trade conditions, and, speaking broadly, at least one-third of the nitrogen in a commercial fertilizer—and more than that proportion if the lower grades are used—should be furnished as nitrate. This is especially true in the northern counties, on the higher altitudes throughout the State, and on the heavier soils. However, the trade conditions of 1916 are such that it may be difficult or impossible to secure adequate supplies of nitrate. It may be necessary—it will be quite sure to be more economical—to use sulphate of ammonia or calcium cyanamid in its stead.

Sulphate of ammonia is less well known than is nitrate to Vermont farmers. It is soluble in water and its nitrogen is readily available to plant growth, though less readily than that in nitrate. It is at the present writing so much cheaper, pound for pound of nitrogen, as to cause it to stand more nearly on a par than usual with nitrate nitrogen on an availability basis. Usually it is not thought to be quite as likely to afford immediate results early in the spring as is nitrate; hence the writer's predilection for the former salt. This is not gainsaying the thorough reliability and usefulness of the sulphate.

Calcium cyanamid as now manufactured seems to be well worth using and recent quotations are eminently satisfactory. Indeed, it is the cheapest available nitrogen now offered. Not more than 200 pounds per ton should be used. In some cases it has seemed to exert a slightly toxic or poisonous effect on the crop and to delay spring germination, a more serious matter in Vermont than in states further south. Temporarily it may irritate the skin and eyes, but only temporary annoyance is to be feared. It is not externally poisonous to man or beast. Its alkalinity and free lime content necessitate its restricted use in mixed goods, 200 pounds being the limit. It may be used mixed with nitrate but not with sulphate of ammonia. Unless used quite promptly after mixing with acid phosphate, to some extent it may impair the availability of the phosphoric acid. It seems to rank with or slightly lower than sulphate of ammonia in its availability, as judged by vegetation tests, and at the outset is not as rapid in its effect as nitrate. On these accounts it may be well to apply a fertilizer containing cyanamid from seven to ten days before seeding.

Organic forms. The buyer of crude stock will do well to get quotations and buy organic nitrogen when he can do so to best advantage, provided its availability is satisfactory. Tankage usually will be chosen. Peruvian guano may be worth considering, although offered at very high prices. Cottonseed meal now is held at high prices and on this account is less likely than usual to be considered.

Farmers should not forget that peat and muck are nitrogenous, though their nitrogen contents relatively are inert; that average manure, if well kept, carries about 10 pounds of nitrogen in a ton and from 25 to 30 pounds in a cord; and that some manufacturing wastes—wool or felt waste for example—are worth using. (In this connection the discussion of the nature of nitrogenous crude stock used for fertilizer purposes on pages 298 to 305 of Vermont Station Bulletin 182 may prove interesting and helpful. It is free for the asking).

PHOSPHATIC. Available phosphoric acid tends to hasten the development of the root system of the crop. Hence it works especially well in starting crops early, enabling them to profit by a longer growing season and making it possible for them to utilize plant food in the soil which otherwise might not be reached.

Acid phosphate, of course, is the most available and best form of phosphatic plant food; but its present inordinately high price will be likely to discourage its use, even on quickly growing crops. Yet it will be used largely, for most commercial brands are built on an acid phosphate basis. More than ever its use should be confined to naturally productive lands and to cash crops.

European basic slag is not in the market. A limited quantity of southern slag of fairly good quality is on sale at a rather high price and may be used to advantage on grass and orchard lands.

Bone meal (raw, or steamed) and *tankage* are relatively slow purveyors of phosphoric acid, although in some cases they have been found—especially the steamed product—to approximate in serviceability to acid phosphate when used for corn and to answer fairly well with other crops, particularly those which are not quick growing but are long-season crops. It tends markedly to improve the texture of mixed goods, to better their physical character.

Floats (ground phosphate rock) are not advised for use in northern New England with the generality of crops. Its phosphoric acid is the slowest of the slow, even when used so superabundantly that a money equivalent of acid phosphate at present high prices is afforded. The field results are not likely to be satisfactory, although at times, on some slow growing crops, like rape, for example, which seem to possess unusual foraging powers, successful results have been attained. Perhaps satisfactory returns may be secured after a considerable lapse of time, but New England farmers buy plant food primarily for a quick turnover and not to put in the soil bank. Favorable results have been attained with floats in some cases when used as a reinforcement of manure which lies for some months to heat and ferment; in others no gains have been noted. When turned under with green manuring crops, or when used on strongly acid soils with crops like potatoes or onions, some results which seem favorable have been secured; but it is quite certain, even under the abnormal conditions of the coming season, that Vermont farmers should not resort to ground phosphate rock for the fertilization of their money crops or their quick growing crops. (In this connection the discussion of the nature of phosphatic crude stock for fertilizing purposes on pages 305 to 310 of Vermont Station Bulletin 182, may prove helpful. It is free for the asking).

POTASSIC. *German potash salts* (muriate, sulphate, kainit) are not for sale. Muriate of potash now is quoted nominally at $530 or more a ton. It sells normally at about $40 a ton. No farmer can afford to buy it, and few farmers can get it in any quantity.

Wood ashes, lime-kiln ashes, brick-kiln ashes, etc. These materials contain more or less potash, generally less. At best a good grade of wood ashes may carry five percent; as a rule they are likely to carry much less than this. They are selling, delivered at New England points, in somewhat limited quantities in carload lots at from $13 to $15 a ton. Assuming a five percent potash content—a liberal assumption—and remembering that ground limestone is offered f. o. b. at Vermont shipping points in carload lots at $1.50 a ton, the potash in high grade wood ashes would cost approximately ten cents a pound. If the ashes are of as poor grade as are offered commonly, a pound of potash may cost 20 or 30 cents a pound. Parties expecting to buy ashes should write the Station, ask how properly to draw samples, and then submit carefully drawn samples to the Station for its free analysis; for buying ashes in the open market nowadays is like "buying a pig in a poke." Wood or other ashes should not be used in combination with nitrogenous materials or acid phosphate, as they induce their deterioration. (In this connection the discussion of the nature of potassic crude stock for fertilizing purposes on pages 310 to 312 of Vermont Station Bulletin 182 may prove helpful. It is free for the asking).

WHAT MAY BE USED AS A SUBSTITUTE FOR POTASH?

There is no thoroughly adequate substitute for potash. Any procedure which may be carried out must be of a makeshift character and relatively unsatisfactory. However, the following suggestions are offered: In the first place wood ashes may be resorted to as a direct supply, as is indicated above; then, recourse may be had to certain so-called indirect fertilizers, more particularly common salt and land plaster; and, finally, reliance may be placed on the subsidiary effects produced by the use of nitrate of soda and acid phosphate.

Common salt. "Salting meadows" is an old time farm practice, long discontinued on any large scale, but worth reviving in 1916. Salt seems to act favorably to some extent with some crops on some soils. Its soda content is thought to replace and to liberate more or less soil potash; to act, in other words, in part as a substitute for potash, to make what potash there is "go further." In a general way the trend of results seems to indicate rather better results with grass than with other crops. Potatoes do not seem to respond, since in several careful trials no benefit occurred. An overdosage is likely to cause lime losses in drainage waters, and on this account, presumably, to increase soil acidity. It is thought by some to render the crop more susceptible to frost injuries. From 150 to 250 pounds to the acre may be used. Refuse salt can be bought of Hon. C. S. Page, Hyde Park, Vermont, at the rate of $4 a ton f. o. b. factory in ton lots. The International Salt Co. of Watkins, N. Y., is said to be quoting $2.50 a ton, f. o. b., Watkins. Apparently salt can be laid down at Vermont points from $4 to $7.

Lime (as gypsum, land plaster). There appears to be a popular notion afloat that lime, in the form of ground limestone, quick or slaked lime, may liberate soil potash. Under average conditions it is doubtful whether lime in these forms may be depended upon materially to increase the available soil potash supply. Doubtless it may serve to release and to render available the potash in organic matter, whether in green manures, plowed-under sward, stubble, farm manure, or organic soil constituents containing potash. However, when applied in the form of gypsum or land plaster, its effect as a soil potash liberator seems more clearly established; yet there are plenty of instances where in this respect it seems to have been inert. Land plaster is not offered commonly in Vermont nowadays and is relatively costly. However, used in the stable, sprinkled in the trenches for the purpose of lessening fermentative losses, doubtless it is well worth using; and, as in the case of nitrate of soda, its effect as a potash purveyor, if any such there is, can be looked upon as a by-product. Probably it is best applied to the soil by way of the stable.

Nitrate of soda. Careful and long continued field trials in England seem clearly to indicate that soil potash to some extent is liberated by the application of nitrate of soda. In this respect it acts much as does salt. Similar trials elsewhere, including some New England points, have not shown the same tendency. However, since nitrate of soda is worth using in moderation for its own sake, its effect as a soil potash liberator, if any such exists, may be accepted as a by-product.

Acid phosphate contains about forty percent of artificial gypsum or land plaster, which serves the same purpose as does the natural product. The buyer of acid phosphate, either as such or in mixed fertilizers—of which it is almost always a principal ingredient—secures several services. If acid phosphate is used, as it may be to advantage, in the trenches at the rate of a pound a day per animal, it tends to save nitrogen, it directly supplies available phosphoric acid, it may free soil potash, and it carries a large lime content in the form of land plaster. *Multum in parvo!*

In this connection it may be said that there seems reason to believe that attempts will be made to sell ground rocks to farmers on the basis of their potash content. Water-insoluble potash in the form of ground rock is not to be relied upon at this juncture. Some day soluble potash will be extracted in a commercial way from feldspar and other potash-bearing rocks, but that day is not today; and, furthermore, this fact has no bearing on the purveyal of insoluble forms of potash. Farmers should buy no materials said to contain potash except on the basis of their guaranteed water-soluble potash content; and they should buy no so-called "potash liberators" without a clear knowledge of their nature. Samples of a doubtful character should be submitted to the Station.

IV. Is Potash Necessary?

How necessary will potash be in 1916 crop growth? The writer is inclined to believe that if the growing season of 1916 is a fairly good one, Vermont farmers will not suffer seriously for lack of potash in the growth of the generality of crops, provided they conserve and intelligently use their home resources and, perhaps, make use of indirect fertilizers or of nitrate of soda and acid phosphate, either in ready mixed or home mixed goods. This faith is based in part on what he deems to be his general knowledge of the past history of Vermont soils, their fertilization and cropping, and in part on the results attained at various points throughout New England.

On the Rhode Island station soils, potash seems relatively unimportant for most crops, other than potatoes, nitrogen and phosphoric acid being relatively more important. Roots, onions, oats, hay and corn, do not respond to potash. On two soils during four seasons, potatoes averaged 20 and 40 percent crop increases, following potash fertilization.

At the New Hampshire station, potash showed little effect on grass.

On the Aroostook (Maine) station farm during the past year, the use of potash, together with a liberal nitrogen and available phosphoric acid supply, increased the potato crop only 7 to 10 percent over that secured when potash was not used.

During the past year in some 70 trials throughout New England on corn and potatoes, a fertilizer carrying approximately 4 percent nitrogen and 10 percent available phosphoric acid seemed to do about as well as did a brand carrying 3¼ percent nitrogen, 8 percent available phosphoric acid and 4 percent potash.

It is only right to say, on the other hand, that potash long has been recognized to be the dominant element on the silt-loam soils at the Massachusetts station in the Connecticut valley; and that at the New Jersey station some twenty trials have shown that fertilizers containing potash have outclassed those containing none.

Soil, crop and season are prime controlling factors; and sweeping statements of general application are not worth the paper they are printed on. But why worry? Let us save all the potash we can, do our best to make use of soil potash, buy none whatever unless we can get good and cheap wood ashes, and sleep soundly!

V. Specific Suggestions as to Soils

1. This is not the time to stress the permanent enrichment, the "building up," of soils by means of purchased plant food.

2. This is not the time to try to grow money crops on the lighter and sandy types of soils. Some special high cost crops may be thus grown; but these are exceptions.

3. This is the time to use the best soils for money crops.

4. This is the time to remember that the heavier soils as a class contain more potash than do the lighter and sandy soils; that, just as in normal times the former are less likely to respond profitably to the application of potash than are the latter, so now they are less likely to suffer for the lack of such application and more likely to produce a normal yield of crops that use potash freely.

5. This is the time for farmers who have used potash somewhat liberally thus far, to bear in mind the previous history of their various fields as regards fertilization and cropping and, to a reasonable extent, to be influenced thereby in their 1916 cropping plans.

6. This is the time for farmers carefully to estimate the probable commercial value of each crop and to use this estimate as a measure of spring plant food usage; to remember that on special crops necessitating high labor costs (e. g. onions, tobacco, which are grown only in a small way in Vermont) fertilizer charges are relatively unimportant; and to remember, on the other hand, that low money value crops, such as are grown commonly in extensive farming practice, will not as a rule repay excessive fertilizer charges.

VI. Specific Suggestions as to Crops

1. *Topdressing grass lands.* Nitrate of soda, 100 to 200 pounds to the acre, easily is the best application for immediate returns, al-

though half nitrate and half calcium cyanamid sometimes has worked well. In some instances repeated applications of nitrate have resulted unfavorably, the grass running out; in other instances no such outcome has been observed. The New Jersey station reports a gain of two tons of hay following a 225 pounds nitrate of soda application. The Maine station applies 100 to 150 pounds dissolved in water, using a potato sprayer for this purpose, thus securing an even and thorough application at a slightly increased cost. In this connection the possible effect of nitrate of soda as a potash liberator should not be forgotten.

Sulphate of ammonia may be used advantageously at the rate of 100 to 150 pounds per acre if employed in conjunction with plenty of lime or on a neutral soil and if used somewhat earlier than one would use nitrate. If in dried and ground form, it can be applied accurately and easily with grain drill. It should not be used in conjunction with cyanamid.

The highly nitrogenous commercial brands may be used to advantage.

(In this connection see the somewhat extended discussion of the topdressing of grass lands on pages 189 to 191 of Vermont Station Bulletin 171; free for the asking).

2. *Topdressing clover and alfalfa.* Normally, basic slag and potash salts, in the proportions of three to one, 500 to 800 pounds to the acre, have proved satisfactory; but neither now are to be had at reasonable prices. Acid phosphate and wood ashes applied separately, perhaps in equal parts, say 600 to 900 pounds to the acre, seem on the whole most advisable; but both are costly and one, perhaps, is of doubtful quality. Hence the writer is inclined to believe that perhaps 1916 may be a good year in which to forget to topdress these crops. (In this connection see the discussion of topdressing on pages 190 to 191 of Vermont Station Bulletin 171; free for the asking).

3. *Corn.* The ordinary practise is advised, namely, 4 to 6 cords, or 10 to 15 tons, of manure, supplemented with 300 to 500 pounds of a fertilizer—either ready mixed or home mixed goods—containing about 2½ to 3 percent nitrogen and about 10 percent of available phosphoric acid. About one-third of the nitrogen ought to be supplied in the form of nitrate of soda, if possible, both on its own account and because of its possible effect as a potash liberator; if this does not seem possible, sulphate of ammonia or calcium cyanamid may serve, but not sulphate of ammonia *and* calcium cyanamid, since they are "incompatibles." In the event that no manure is used, a rare occurrence in Vermont, the usage of the commercial goods may be increased by

at least two-thirds; and, in the writer's judgment, the likelihood of a profitable outcome will be apt to be decreased. (In this connection see the discussion of corn fertilization on pages 346 and 347 of Vermont Station Bulletin 189; free for the asking).

4. *Oats, barley, seeding down to grass.* It is, of course, a common procedure to sow grain following corn directly or with a year's interval, depending upon the residual plant food for the forcing of crop growth. If a fertilizer is used at all, nitrate of soda may be sown in small amounts, or a 300 to 500 pound application may be made in the spring of a ready mixed or home mixed goods carrying 4 to 5 percent nitrogen and 8 to 10 percent available phosphoric acid. The nitrogen should be used largely in the mineral form, and preferably as nitrate for reasons hitherto cited, though cost considerations may make it impracticable to do this. If the seeding is done in the fall, or if winter rye is sown, no nitrate should be used. (In this connection see the discussion of seeding down fertilization for grass, oats, barley and clover on pages 186 to 189 of Vermont Station Bulletin 171; free for the asking).

5. *Potatoes, vegetables, small fruit.* Farm manure may be used if fairly well decomposed and if worked well into the soil, perhaps five tons to the acre, together with about 500 pounds of a ready mixed or home mixed goods carrying from 2½ to 3 percent nitrogen and 8 to 10 percent available phosphoric acid, approximately one-third of the nitrogen to be preferably in the form of nitrate, for reasons hitherto advanced, although cost considerations may make this impracticable. On the other hand where scab is feared, sulphate of ammonia which tends, if anything, to acidify soils may serve the purpose better than nitrate. The manure will furnish from 40 to 50 pounds of potash and the nitrate of soda, and, also, the artificial gypsum or land plaster of the acid phosphate, which is used in all fertilizers, may help out the scanty potash supply. To some extent the manure may increase the likelihood of a scabby potato crop, but the scab, like the poor, always is with us and even with the utmost care often cannot be avoided. Ashes may be used to the extent of 1,000 pounds if broadcasted and worked in carefully. They should be separately applied. Their effect on scab is quite likely to be unfavorable. However if potato growers plant a russet variety, such for example as the Cambridge Russet, Burbank's Russet, Dibble's Russet or Scab Proof, the likelihood of scab injury is but slight.

If no manure is used, a considerably larger amount, upward of 1,000 pounds, of a goods carrying perhaps 4 percent nitrogen (5 percent ammonia) and 8 to 10 percent available phosphoric acid may be used, preferably 10 percent.

Many potato growers doubtless will feel like buying goods carrying one percent potash in order to get some potash. This does not seem to the writer to be a case where a half-loaf is better than no bread. It is but a sixth of a loaf. The one percent will be costly and will be but a drop in the bucket, but five pounds in a 500-pound application. While the results of field trials are very conflicting and it is difficult to deduce definite results which are of general application, there seems a fair consensus of opinion among those whose experience entitles them to express an opinion to the effect that small applications of potash are quite ineffective in potato growing. The North Atlantic State directors are a unit in their belief that under the peculiar conditions of the coming season ammoniated superphosphates without potash usually are to be preferred to one percent potash goods.

6. *Orchards.* The results of orchard fertilization trials are highly dissimilar. Long continued work in New York and in Maine has resulted negatively. On the other hand, a famous Massachusetts orchard has responded wonderfully to fertilization. Under the conditions of this year, adequate tillage together with winter covers seems the safer procedure. Indeed, moisture conditions and not the plant food supply seem controlling factors in orchard management.

VII. WHAT SORT OF COMMERCIAL FERTILIZERS WILL BE SOLD?

The fertilizer manufacturers selling in Vermont have not listed their 1916 brands at the time when this circular is being issued; but it is clear from the statements voluntarily made by trade representatives that a few brands carrying 1 percent of potash will be offered; that a large proportion of the brands will carry no potash; that the available phosphoric acid contents almost invariably will be confined within narrow limits, from 8 to 10 percent; and that the chief variations this year as between different brands will be in the nitrogen contents, which will range from 0.8 (1 percent ammonia) to 4.9 percent nitrogen (6 percent ammonia). There seems no reason at present to believe, on account of the untoward conditions now existing, that either the quantity or quality of the plant food which will be sold by the fertilizer trade will be inferior in any respect to that hitherto furnished by the manufacturers selling in Vermont, save, of course, that potash will be a minus quantity.

VIII. SHOULD READY MIXED OR HOME MIXED GOODS BE USED?

Vermont farmers have been buying crude stock and mixing at home to a greater extent this past year than ever before—generally with satisfactory results, both as to money saving and crop growth. Less satisfactory results are likely to be secured in 1916. Fertilizers and fertilizer crude stock will cost much more than formerly; and, since potash is a minus quantity, the field results may be affected.

When conditions are normal, crude stock may be bought for cash in large quantities in cooperation at lower prices than those at which mixed goods can be purchased in large quantities for cash; but it may be in this unusual year that better trades can be made in mixed than in unmixed goods. For most of the mixed goods were made when nitrate sold at $49, sulphate of ammonia at $71, when tankage sold around $30, acid phosphate at $7; whereas these articles are now quoted at wholesale at the seaboard at approximately $65, $80, $35 and $14 respectively. Some brands carry one percent of potash. Muriate of potash sold in August at $250; it is now quoted at $530. Buyers of crude stock who seek to place their orders this winter will of course be handicapped as compared with those whose orders were placed in mid-summer—and few such exist—or with manufacturers who buy throughout the year. It well may be that farmers can get more for their money in 1916 by buying the ready made goods, made when materials cost less than they do now, than by buying high-priced crude stock. It is for each man to figure the relative costs and buy accordingly. In this connection it may not be amiss to say that nitrate nitrogen probably can be bought to better advantage in 1916 in mixed goods than in crude stock; and nitrate of soda is a most valuable form in which to supply Vermont crops with nitrogen.

Because of high prices farmers more than ever should endeavor to make a dollar go as far as it will; should get quotations from several manufacturers or dealers; should pay cash, if possible, for the reason that credit purchases cover high interest charges; should buy in cooperation with others, as so many Vermont farmers are now doing; and should buy on a guaranty basis.

SUMMARY

1. Commercial fertilizers and the materials from which they are made will cost more in 1916 than hitherto, because:

(a) The available potash supply is exhausted.

(b) The munitions trade is using much of the material hitherto employed in commercial fertilizer manufacture; more expecially sulphuric acid and nitrate of soda.

(c) The phosphoric mines are largely shut down.

(d) Coastwise freights are scarce and high.

(e) The blocking of the Panama Canal temporarily has hindered nitrate importations.

(f) Practically all forms of crude stock have risen in price sympathetically.

2. In this juncture farmers should:

(a) Till their soils to best advantage.

(b) Husband home manurial resources, especially the liquid manure.

(c) Apply manure more carefully.

(d) Conserve all wood ashes.

(e) Lime acid soils.

(f) Pay more than usual attention to underdrainage, adequate crop rotation, etc.

3. Concerning plant food sources:

(a) *Nitrogenous.* Nitrate of soda is costly, but is the most available form of nitrogen; sulphate of ammonia is well worth using; and calcium cyanamid is the cheapest form of nitrogen now being offered, though open to minor objections. Tankage and other approved organic ammoniates are costly, but as a rule are necessary.

(b) *Phosphatic.* Acid phosphate is very costly but by far the most available source of phosphoric acid; bone meal and tankage are fairly satisfactory forms; basic slag practically is unattainable; floats (ground phosphate rock) should not be relied upon for use in northern New England.

(c) *Potassic.* Potash salts are not for sale; wood ashes, etc., should be saved carefully and, if bought, should be purchased on guaranty and analysis; ground feldspar, etc., is quite useless as a purveyor of potash.

(d) Potash substitutes do not exist. However, certain materials, salt, land plaster, nitrate of soda, acid phosphate, under some circumstances, seem to free soil potash. Their use is advised in a limited way.

4. Vermont farmers probably can get along in 1916 without much purchased potash. This judgment is based on past experience and experiment. They will have to, anyway.

5. Suggestions as to soils.

"Permanent agriculture" and the attempted growth of money crops on light and sandy soils are not for 1916. The best soils, well handled, are none too good. Heavy soils will best withstand a shortage of manurial potash. More carefully in 1916 than ever before, the relation of the probable cash value of the crop should be weighed against a proposed expenditure for plant food.

6. Suggestions as to crops:

(a) *Topdressing grass lands.* Nitrate of soda 100 to 200 pounds, or a half nitrate and half cyanamid application, 100 to 200 pounds, or 100 to 150 pounds of sulphate of ammonia may be used. The highly nitrogenous commercial brands may be used to advantage.

(b) *Topdressing clover and alfalfa.* Wood ashes, if obtainable, probably are the best thing to use in view of the conditions of 1916.

(c) *Corn.* Four to six cords (10 to 15 tons) manure and 300 to 500 pounds of a fertilizer carrying about 2½ to 3 percent nitrogen (one-third as nitrate if practicable; if not either—not both—cyanamid or sulphate of ammonia) and about 10 percent available phosphoric acid are suggested.

(d) *Oats, barley, seeding down.* Nitrate of soda in the spring in small amounts, or a 300 to 500 pound application of a fertilizer carrying 4 to 5 percent nitrogen (largely mineral) and 8 to 10 percent available phosphoric acid may be employed.

(e) *Potatoes, vegetables, small fruits.* Five tons of well rotted manure and about 500 pounds of a fertilizer carrying 2½ to 3 percent nitrogen and 8 to 10 percent available phosphoric acid, the nitrogen to be partly mineral as stated above in (c) are suggested. Russet varieties of potatoes will resist the scab. If no manure is used, a formula carrying 4 percent nitrogen and 8 to 10 percent available phosphoric acid may be used.

(f) *Orchards.* Adequate tillage rather than fertilization is advised.

7. Manufacturers will sell in the main ammoniated superphosphates without potash. A few brands will carry one percent potash. The purchase of the latter at high prices for the potash is not advised. One percent rarely will be found to be worth while.

8. It is quite possible that under the peculiar conditions obtaining this year, ready mixed goods may sell in some instances at a less price than will the crude ingredients; that, in other words, home mixing will be done at a loss. Whenever possible farmers should secure quotations from several sources and buy cooperatively for cash.

Vermont Agricultural Experiment Station
Burlington, Vt.

CIRCULAR NUMBER 11

October, 1916

CONCERNING CERTAIN TECHNICAL BULLETINS AND CONCERNING THE ANNUAL REPORT

At this date the Station is issuing a considerable number of bulletins, some of which will and some of which will not be generally distributed. In order clearly to set forth this situation so that parties who do not receive all of the numbers, 194 to 201 inclusive, may know the reason for the omissions and may learn how to secure what has not been sent, as well as to describe a change in policy as to the issuance of the annual report, this circular has been prepared.

CONCERNING BULLETINS 194 TO 201

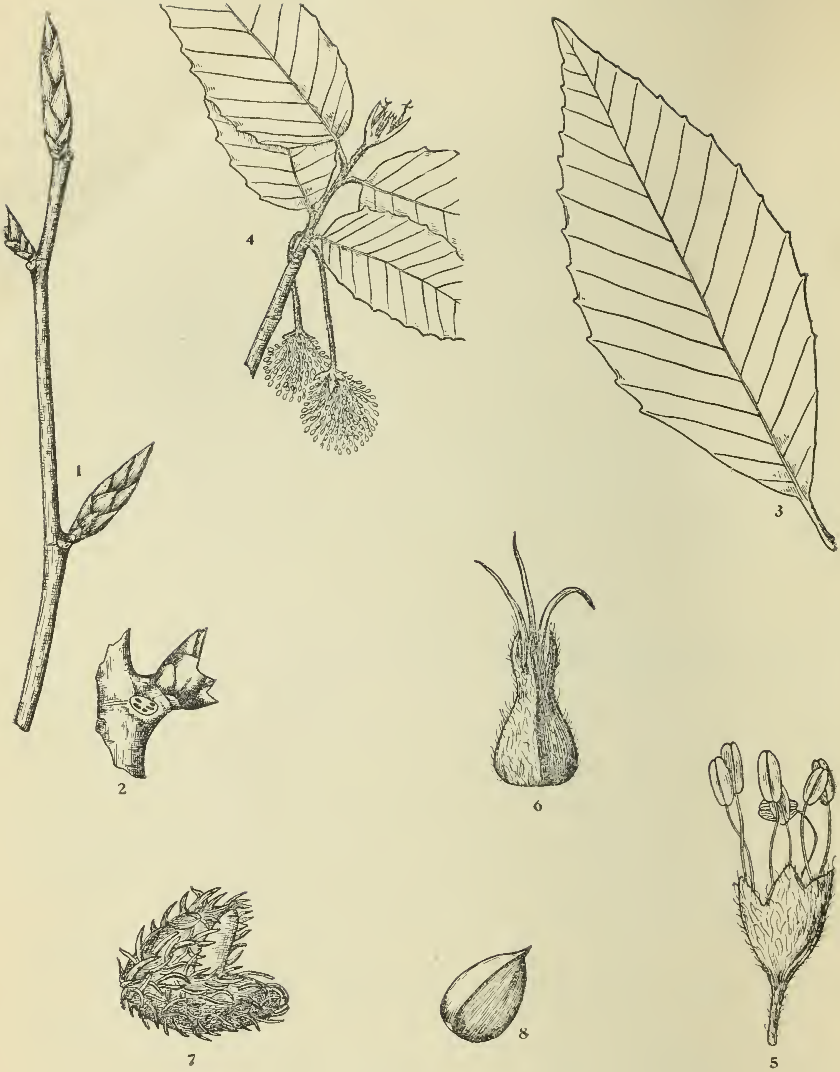
The following bulletins are being distributed:

No. 194. The Trees of Vermont. 244 pages. A profusely illustrated discussion of the trees of Vermont, with keys for identification of the various trees and their timbers. Nine thousand copies of this bulletin have been supplied to the public schools of the State. *It will not be sent to the regular mailing list in or out of the State, but will be sent without charge to any person who may request a copy.* (Sample pages are shown on pages 2 and 3 of this circular).

No. 195. Studies of the Values of Different Grades of Milk in Infant Feeding. 144 pages. A technical presentation of the results of many years of experimentation. No. 201 is a popular presentation of the same subject, a condensed statement. *The larger bulletin (No. 195) will not be sent to the regular mailing list in or out of the State, but will be sent without charge to any person who may request a copy.* The popular bulletin (No. 201) will afford some idea of the nature of the more technical issue.

No. 196. Studies on Bordeaux Mixture. 80 pages. A technical presentation dealing with the ways in which bordeaux accomplishes its beneficial work. *It will not be sent to the regular mailing list in or out of the State, but will be sent without charge to any person who may request a copy.*

Beech



(Mich. Trees).

1. Winter twig, x 1.
2. Portion of twig, enlarged.
3. Leaf, x ½.
4. Flowering branchlet, x ¾.
5. Staminate flower, enlarged.
6. Pistillate flower, enlarged.
7. Bur, opened, x 1.
8. Nut, x 1.

FAGACEAE

Beech

Fagus grandifolia Ehrh. [Fagus atropunicea (Marsh.) Sudw.] [Fagus ferruginea Ait.] [Fagus americana Sweet]

Habit.—A beautiful tree, rising commonly to a height of 50-75 feet, with a trunk diameter of 2-4 feet; in the forest, tall and slender, with short branches forming a narrow crown, in the open with a short, thick trunk and numerous slender, spreading branches, forming a broad, compact, rounded crown.

Leaves.—Alternate, simple, 3-5 inches long, one-half as broad; oblong-ovate, acuminate; coarsely serrate, a vein terminating in each tooth; thin; dark blue-green above, light yellow-green and very lustrous beneath; petioles short, hairy.

Flowers.—May, with the leaves; monoecious; the staminate in globose heads 1 inch in diameter, on long, slender, hairy peduncles, yellow-green; calyx campanulate, 4-7-lobed, hairy; corolla 0; stamens 8-10; the pistillate on short, hairy peduncles in 2-flowered clusters surrounded by numerous awl-shaped, hairy bracts; calyx urn-shaped, 4-5-lobed; corolla 0; ovary 3-celled; styles 3.

Fruit.—Ripens in autumn; a prickly bur borne on stout, hairy peduncles, persistent on the branch after the nuts have fallen; nuts usually 3, ¾ inch long, sharply tetrahedral, brownish; sweet and edible.

Winter-buds.—Nearly 1 inch long, very slender, cylindrical, gradually taper-pointed, brownish, puberulous.

Bark.—Twigs lustrous, olive-green, finally changing through brown to ashy gray; close, smooth, steel-gray on the trunk, often mottled by darker blotches and bands. Plate IV.

Wood.—Hard, tough, strong, very close-grained, not durable, difficult to season, light or dark red, with thin, whitish sapwood. Page 227.

Distribution.—Abundant throughout Vermont.

Habitat.—Rich uplands; moist, rocky soil.

Notes.—The beech, when growing in the forest, with its tall, graceful trunk, its smooth, gray bark and shiny leaves, is a handsome tree. It is not only one of the most common trees in Vermont, but also one of the most widely distributed in eastern North America. The drooping clusters of pollen-bearing flowers and the short, stout ovule-bearing heads open under the newly spreading leaves in early May. The burs open and the nuts fall with the first frosts of autumn.

No. 197. Commercial Feeding Stuffs: Concerning the Oat Crop. 72 pages. Sent to entire mailing list.

No. 198. Commercial Fertilizers: Concerning Tillage. 84 pages. Sent to entire mailing list.

No. 199. Twenty-ninth Annual Report. 16 pages. Sent to entire mailing list.

No. 200. Agricultural Seed: Concerning Weeds and Weed Seeds. 80 pages. Sent to entire mailing list.

No. 201. Different Grades of Milk in Infant Feeding. 32 pages. Popular presentation of No. 195. Sent to entire mailing list.

Any or all of these bulletins will be sent without charge on application. A postal card addressed to Experiment Station, Burlington, Vermont, stating desires is sufficient.

CONCERNING THE ANNUAL REPORT

For nearly ten years the policy in relation to report printing has been such that the annual statement as to conduct of the Station's business affairs has not received wide distribution throughout the State. The report has been printed only in limited numbers. Beginning with the issue covering the fiscal year ending June 30, 1916, a new policy has been inaugurated. The report will be printed in two forms:

1. As a bound volume, in an edition of 1,500, comprising:
    (a) The report proper, usually 16 to 24 pages.
    (b) The bulletins of the year.
2. As a bulletin by itself (e. g., No. 199).

The material is identical in each case, the pagination only being altered. In future bound volume reports, the bulletin-report (e. g., No. 199) of the preceding year will not be included, but a reference page will be inserted calling attention to the nature of the omitted bulletin and referring to the previous issue.

VERMONT AGRICULTURAL EXPERIMENT STATION, BURLINGTON, VT.

CIRCULAR NO. 12 (1924 EDITION)

Publications for Free Distribution to Schools

The Station has issued to date (Oct., 1924) 32 annual reports, 243 bulletins, 13 circulars and divers fugitive publications. Many of these are out of print. Several of these which are in print have now no value whatsoever, except for filling library files. The following numbers are being used to a greater or less extent in secondary schools in various sections of the country and to some extent in Vermont as texts and for reference purposes.

Any or all of these listed below will be sent without charge to any school teacher for school room purposes. Most of them will be sent without charge to any high school scholar who needs them for school purposes. A postal card, addressed to the Experiment Station, Burlington, Vermont, stating desires (use bulletin numbers) is sufficient; or this list properly checked may be returned.

BOTANY: NATURE STUDY.

94 Vermont Grasses and Clovers.
145 Vermont Shrubs and Woody Vines.
146 The Grass and Clover Seed Trade of Vermont.
187 Flora of Vermont; List of Ferns and Seed Plants Growing Without Cultivation.
194 The Trees of Vermont.
200 Concerning Weeds and Weed Seeds.
205 Concerning the Germination of Seed.

CROPS

149 A Practicable Method of Killing Witch Grass.
171 Concerning the Vermont Hay Crop.
189 Concerning the Corn Crop.
197 Concerning the Oat Crop.
204 Concerning Alfalfa and Soy Beans.

SOILS AND FERTILIZERS.

123 The Moisture Relations of the Soil.
143 Soil Physiography.
154 Soil Classifications and Adaptations.
165 Vermont Peats and Mucks.
173 The Principles of Land Drainage.
182 Concerning Irrigation.
190 Concerning Crop Rotation.
198 Concerning Tillage.
206 Concerning Farm Manures.
207 The Manufacture of Commercial Fertilizers.
240 Commercial Fertilizers.

STOCK FEEDING

138 The Viability of Weed Seeds in Feeding Stuffs.
144 Concerning Commercial Feeding Stuffs.
152 Principles and Practice of Stock Feeding.
158 Concerning Feeding Standards; Summer Soiling Suggestions.
180 Concerning Feeding Practice.
229 The Protein and the Maintenance Requirements of Dairy Cattle.
242 Commercial Feeding Stuffs.

FORESTRY

139 Forestry Problems for Farmers.
156 The Management of Vermont Forests with Special Reference to White Pine.
176 The Management of Second Growth Hardwoods in Vermont.
188 Forest Planting in Vermont As An Investment.

HORTICULTURE—PLANT DISEASES

141 Apple Culture in Vermont.
159 Plant Diseases; Twenty Years Spraying for Potato Diseases; Potato Diseases and the Weather.
177 Large Seed a Factor in Plant Production.
186 Farm Apple Storage.
221 First Fifteen Years of a 40-Variety Apple Orchard; Apple Cion Selection from High and Low Yielding Parent Trees.
222 Yield and Quality in Hubbard Squash.

DAIRYING

170 Butter Moisture Content, Dairy Ascutcheons, etc.
202 (Articles on dairy husbandry).
208 The Cost of Producing Market Milk in 1916-17 on 212 Vermont Farms.
213 Cold Storage of Cottage and Other Soft Curd Cheeses.

MAPLE PRODUCTS

151 "Buddy Sap."
203 (Articles on horticulture and maple products).
227 Marketing Vermont Maple-Sap Products.

30.7
59/c

VERMONT AGRICULTURAL EXPERIMENT STATION,
BURLINGTON, VT.

Circular 13 **March, 1926**

The Vermont Station is distributing bulletins 244-253, inclusive.

Nos. 244 and 247 set forth the results of feed inspection; No. 253 the results of seed inspection; and 248 the results of fertilizer inspection, together with 15 pages of discussion concerning fertilizer usage.

No. 249 is a 32-page annual report.

No. 245—*Giant Hill Tubers a Dangerous Source of Seed* (12 pages), A. H. Gilbert—sets forth dangers inherent in the not infrequent choice of over-large potatoes as seed.

No. 246—*The Manufacture of Commercial Feeding Stuffs* (40 pages), J. L. Hills—is an illustrated exposition of the methods used in making feeds.

No. 250—*A Study of Vermont Dairy Farming* (56 pages), J. A. Hitchcock—sets forth the results of two years' intensive study of the farming procedure in two Vermont towns.

No. 251—*Hubbard Squash in Storage* (36 pages), M. B. Cummings and E. W. Jenkins—sets forth the results of several years' trials of various storage methods.

No. 252—*Senescence and Rejuvenescence in the Cells of the Potato Plant* (102 pages), B. F. Lutman—discusses plant cell structure changes in their relations to youth and old age.

Any of these bulletins will be mailed without charge on application as long as they remain in print.

Experiment Station,
Burlington, Vt.

A postal card stating desires and using bulletin number is sufficient.

VERMONT AGRICULTURAL EXPERIMENT STATION,
BURLINGTON, VT.

Circular No. 14 (1929 Edition)

CLASSIFIED LIST OF AVAILABLE PUBLICATIONS
(March, 1929)

Any publication listed below will be sent without charge to any address on application. A postal card to the Experiment Station, Burlington, Vt., stating desires, is sufficient. In case several numbers are desired it is suggested that they be checked on this list and the list returned to the Station.

Do not fail to write name and P. O. address plainly. Lists are sometimes returned with illegible writing or without address.

The bulletins and reports were issued about as follows:

1886-1899.	Bulletins	1- 83.	Reports	I-XIII.
1900-1904.	Bulletins	84-110.	Reports	XIV-XVIII.
1905-1909.	Bulletins	111-147.	Reports	XIX-XXIII.
1910-1914.	Bulletins	148-185.	Reports	XXIV-XXVIII.
1915-1919.	Bulletins	186-215.	Reports	XXIX-XXXI
1920-1929.	Bulletins	216-293.	Reports	XXXII-XLII.

I. Agricultural Seed

146 The Grass and Clover Seed Trade of Vermont.
170 "Mony Meikles Mak a Muckle" I (articles on dairy husbandry, weeds, seeds).
205 Concerning the Germination of Seed.
288 Agricultural Seed (1928 issue).

II. Agricultural Seed (annual inspection bulletins, 1913 to 1927; of no current value except for filling files; should not be requested except for file filling purposes). 183, 192, 216, 220, 223, 228, 233, 241, 253, 259, 277.

III. Animal Disease

230 Concerning Blood Complement.
231 Concerning Infectious Abortion.

IV. Animal Nutrition, including Dairy Feeding

129 Feeding Trials; Frosted Silage; Alfalfa Meal.
137 Feeding Trials; Briefs of Sundry Trials.
152 Principles and Practice of Stock Feeding.
158 Concerning Feeding Standards; Summer Soiling Suggestions.
180 Concerning Feeding Practice.
225 The Protein Requirements of Dairy Cows.
226 The Maintenance Requirements of Dairy Cattle.
229 The Protein and the Maintenance Requirements of Dairy Cattle.
243 Feeding Cocoa Meal to Dairy Cows.
262 Exercise as a Factor in Digestion Trials with Dairy Cows.
270 Apparent Digestibility as Affected by Length of Trial and by Certain Variations in the Ration.
271 Feeding Cocoa Meal to Hogs.
272 Effect of Feeding Cocoa Meal to Milking Cows.
273 Returns from Skimmilk Fed to Hogs under Vermont Conditions.
284 Feeding Cocoa Meal to Dairy Heifers.

V. **Annual Reports** (dealing in the main with matters connected with station organization, financial reports, lists of and brief outlines of progress in station work; numbers other than the current issue have no material value except for purposes of file filling and should not be requested save for that purpose). 10, 199 (29th), 208 (30th), 212 (31st), 249 (32nd-38th), 260 (40th), 276 (41st), 291 (42nd).

VI. **Commercial Feeding Stuffs** (annual or semi-annual inspection bulletins, 1899 to 1927; of no current value except for filling files; should not be requested except for file filling purposes). 68, 78, 82, 84, 91, 97, 109, 110, 117, 118, 124, 125, 131, 133, 216, 220, 223, 228, 236, 237, 242, 244, 266, 281.

VII. **Commercial Fertilizers** (annual inspection bulletins, 1887 to 1927; of no current value except for filling files; should not be requested except for file filling purposes). 2, 14, 23, 35, 41, 45, 46, 51, 52, 57, 58, 64, 69, 80, 86, 87, 92, 93, 98, 99, 107, 108, 112, 121, 126, 134, 140, 166, 216, 220, 223, 228, 234, 240, 254, 258, 278.

VIII. Dairy Farming—Cost Studies

209 The Cost of Producing Market Milk in 1916-17 on 212 Vermont Farms.
250 A Study of Vermont Dairy Farming; I. Randolph-Royalton Area.
256 Studies in Vermont Dairy Farming; II. Enosburg, Franklin Co., Area.
268 Studies in Vermont Dairy Farming; III. Randolph-Royalton Area.
283 Studies in Vermont Dairy Farming; IV. Cabot-Marshfield Area.

IX. Dairying

21 The "Beimling" Milk Test; Testing Milk at Creameries and Cheese Factories.
128 The Testing of Cows.
129 Effect of Freezing Milk on Creaming, Churning and Butter Quality.
129 Effect of Age of Cow on Milk Yields.
137 Dairy Husbandry; Briefs of Sundry Experiments.
170 "Mony Meikles Mak a Muckle" I (articles on dairy husbandry, weeds, seeds).
202 "Mony Meikles Mak a Muckle" II (articles on dairy husbandry).
213 Cold Storage of Cottage and Other Soft Curd Cheeses.
263 Preparation of Butter Samples for Analysis.
264 A Comparison of the Methylene Blue Reduction Test and the Agar Plate Count for Determining Quality of Milk.
265 The Trier Method of Sampling Butter for Analysis.
269 Elasticity of Supply of Milk from Vermont Plants: Factors Affecting Average Delivery per Patron: 1. The Milk-Feed Price Ratio.
274 Thermophilic and Thermoduric Micro-organisms with Special Reference to Species Isolated from Milk. II. The Thermal Resistance of Micro-organisms.
275 Thermophilic and Thermoduric Micro-organisms with Special Reference to Species Isolated from Milk. IV. Effect of Age on Culture of the Heat Resistance of Non-sporulating Bacteria.

X. Feeding Stuffs

144 Concerning Commercial Feeding Stuffs.
164 Condimental Feeds.
246 The Manufacture of Commercial Feeding Stuffs.
247 Concerning Grain Screenings.
290 Commercial Feeding Stuffs (1928 issue).
293 Commercial Feeding Stuffs (1929 issue).

XI. Fertilizers and Fertilization

116 Commercial Fertilizers—How, When and What to Use.
165 The Peat and Muck Deposits of Vermont.
206 Concerning Farm Manures.
207 The Manufacture of Commercial Fertilizers.
211 The Aerial Fertilization of Plants with Carbon Dioxid.
248 Concerning Fertilizer Practise.
287 Commercial Fertilizers (1928 issue).

XII. Field Crops

94 Vermont Grasses and Clovers.
129 Alfalfa Culture in Grand Isle County.
137 Vermont Field Crops.
171 Concerning the Vermont Hay Crop.
189 Concerning the Corn Crop.
197 Concerning the Oat Crop.
204 Concerning Alfalfa and Soy Beans.

XIII. Forestry

102 The Measurement of Saw Logs.
120 Planting White Pine in Vermont.
137 The Damping Off of Coniferous Seedlings.
139 Forestry Problems for Farmers.
156 The Management of Vermont Forests with Special Reference to White Pine.
157 The Damping Off of Coniferous Seedlings.
176 The Management of Second Growth Hardwoods in Vermont.
178 Tolerance of New England Forest Trees; I. Development of White Pine Seedlings in Nursery Beds.
181 Tolerance of New England Forest Trees; II. Relation of Shade to Evaporation and Transpiration in Nursery Beds.
188 Forest Planting in Vermont As An Investment.
191 The Red Rot of Conifers.
193 Tolerance of New England Forest Trees; III. Discontinuous Light in Forests.
194 The Trees of Vermont.
210 The Frustrum Form Factors of Hard Maples and Yellow Birch.
219 Eccentric Growth and the Formation of Red Wood in the Main Stem of Conifers.
235 Tolerance of New England Forest Trees; IV. Minimum Light Requirement Referred to a Definite Standard.
238 The Effects of Air Temperature and Relative Humidity on the Transpiration of Pinus Strobus.
257 Tolerance of New England Forest Trees; V. Relation of the Moisture Content of the Soil to the Sensitiveness of the Chloroplast to Light.
261 Tolerance of New England Forest Trees; VI. A Portable Instrument for Measuring Solar Radiation in Forests.
267 Tolerance of New England Forest Trees; VII. Leaf Efficiency in Thrifty and Stunted White Pine Seedlings.
282 Tolerance of New England Forest Trees; VIII. Effect of Spacing in a Jack Pine Plantation.

XIV. Genetics

217 Blackberries of New England—Their Classification.
218 Blackberries of New England—Genetic Status of the Plants.
239 Some Natural Violet Hybrids of North America.
279 Studies in North American Violets; I. General Considerations.

XV. Horticulture

90 Apple Growing in Addison County.
113 Preparation and Use of Sprays.
129 Anesthetics in Plant Forcing.
131 Apple Growing in Vermont.
136 Moisture and Decay Loss in Stored Hubbard Squash.
136 Drug Plant Cultivation in Vermont.
138 The Montreal Market Muskmelon Industry.
150 The Rôle of Anesthetics and Other Agents in Plant Forcing.
163 Mendalian Inheritance in the Carnation.
169 Cultural Studies of the Montreal Market Muskmelon.
177 Large Seed a Factor in Plant Production.
186 Farm Apple Storage.
203 "Mony Meikles Mak a Muckle" III (articles on horticulture and maple products).
221 First Fifteen Years of a 40-Variety Apple Orchard; Apple Cion Selection from High- and Low-yielding Parent Trees.
222 Yield and Quality in Hubbard Squash.
232 Sterility of Strawberries; Strawberry Breeding.
251 Hubbard Squash in Storage.
255 First 20 Years of a Variety Apple Orchard.
280 Pure Line Studies with Ten Generations of Hubbard Squash.

XVI. Human Nutrition

195 The Values of Different Milk Grades in Infant Feeding.
201 Value of Different Grades of Milk in Infant Feeding.

XVII. Maple Products

105 The Maple Sap Flow.
151 "Buddy" Sap.
167 Micro-organisms of Maple Sap.
203 "Mony Meikles Mak a Muckle" III (articles on horticulture and maple products).
285 Economics of the Farm Manufacture of Maple Syrup and Sugar.
286 Economics of the Farm Manufacture of Maple Syrup and Sugar.
292 Economics of the Farm Manufacture of Maple Syrup and Sugar.

XVIII. Plant Life

145 Vermont Shrubs and Woody Vines.
187 Flora of Vermont; List of Ferns and Seed Plants Growing Without Cultivation.

XIX. Plant Diseases (other than of potatoes)

129 Plant Disease Occurrence in Vermont in 1906.
136 Plant Disease Occurrence in Vermont in 1907.
136 Apple, Plum, Oat and Vegetable Diseases.
148 A Bacterial Soft Rot of Muskmelon.
157 The Damping Off of Coniferous Seedlings.
175 Studies on Club Root.
185 Studies on Club Root.
191 The Red Rot of Conifers.
196 Studies on Bordeaux Mixture.

XX. Potatoes and Potato Diseases

85 Potato Scab.
115 Disease Resistant Potatoes.
129 Potato Leaf Blotch Disease; Blackleg; Spraying Trials.
136 Potato Diseases and Their Remedies.
142 Plant Diseases; Potato Spraying.
153 Plant Diseases; Potato Spraying.
168 Investigations of the Potato Fungus Phytophthora Infestans.
172 Place-Effect Influence on Seed Potatoes.
179 Disease Resistance of Potatoes.
184 Potato Scab.
214 Tip Burn of the Potato and Other Plants.
215 Resistance of Potato Tubers to Scab.
245 Giant Hill Tubers a Dangerous Source of Seed.
252 Senescence and Rejuvenescence in the Cells of the Potato Plant.
289 Net Necrosis of Irish Potato Tubers.

XXI. Soils

130 Soil Biology.
135 Soil Deterioration and Soil Humus.
143 Soil Physiography.
154 Soil Classifications and Adaptations.
173 The Principles of Land Drainage.
182 Concerning Irrigation.
190 Concerning Crop Rotation.
198 Concerning Tillage.

XXII. Weeds

137 Weeds
138 Commercial Feeding Stuffs; The Viability of Weed Seeds in Feeding Stuffs.
170 "Mony Meikles Mak a Muckle" I (articles on dairy husbandry, weeds, seeds).
200 Concerning Weeds and Weed Seeds.

UNIVERSITY OF ILLINOIS-URBANA
630.7V591C C002
CIRCULAR
1-14
3 0112 019898003